

THE ROLE OF FEDERAL LANDS IN COMBATING CLIMATE CHANGE

OVERSIGHT HEARING

BEFORE THE

SUBCOMMITTEE ON NATIONAL PARKS, FORESTS
AND PUBLIC LANDS

OF THE

COMMITTEE ON NATURAL RESOURCES

U.S. HOUSE OF REPRESENTATIVES

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OVERSIGHT HEARING ON “THE ROLE OF FEDERAL LANDS IN COMBATING CLIMATE CHANGE”

**Tuesday, March 3, 2009
U.S. House of Representatives
Subcommittee on National Parks, Forests and Public Lands
Committee on Natural Resources
Washington, D.C.**

The Subcommittee met, pursuant to call, at 2:00 p.m. in Room 1324, Longworth House Office Building, Hon. Raúl M. Grijalva [Chairman of the Subcommittee] presiding.

Present: Representatives Bishop, Hastings, Napolitano, Holt, Heinrich, Christensen, Kind, Capps, Inslee, Herseth Sandlin, Sarbanes, Shea-Porter, Tsongas, Coffman, and Lummis.

STATEMENT OF THE HONORABLE RAÚL M. GRIJALVA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ARIZONA

Mr. GRIJALVA. Thank you. Let me call the Subcommittee on National Parks, Forests and Public Lands oversight hearing to order. The subject of this hearing is the role of Federal land in combating climate change, and today our Subcommittee will be conducting an oversight hearing to explore the role of Federal lands in combating climate change.

This will be the first in a series of hearings our Subcommittee will conduct on climate change. Today's hearing will focus primarily on the Forest Service and Bureau of Land Management lands. We expect to schedule a future hearing on National Park Service lands and climate change.

The impact of climate change on our Federal lands is staggering. Science shows that climate change will cause a spread of invasive species, threaten native species, endanger watersheds, cause habitat loss, and increase the intensity and length of the fire season on our public lands.

Today, we will be hearing more on these impacts and suggested policy solutions by reputable scientists, such as Mark Harmon from Oregon State University.

Climate change not only threatens the world-class resources of our public lands but also the millions of Americans who depend on and enjoy our Federal lands.

Today, we will also be hearing from witnesses about the role of rural public lands communities in combating climate change. We

will receive the perspectives of Indian Country, the Human Power Recreation Community, and the hunter-angler community on this topic.

There are two potential climate change solutions that I am particularly interested in exploring today.

The first is climate change adaptation. Rick Ridgeway from Freedom To Roam will testify today about connecting habitat in order for wildlife to adapt to the impacts of climate change.

The second solution we will explore is whether some of the key laws under the jurisdiction of the Committee on Natural Resources adequately reflect the reality of climate change. These laws include the National Environmental Policy Act [NEPA], as well as various organic acts for land management agencies.

The State of California has moved far beyond the Federal government in this area by releasing a draft guidance for integrating climate change into the California Environmental Quality Act. Today, we will be hearing from Mr. Tony Brunello about California's efforts, and perhaps this can provide good guidance on our Federal efforts.

President Obama has made climate change a top issue on his agenda. Today, I am pleased that we are joined by representatives of the Obama Administration to hear what ongoing work and future plans are for combating climate change on our public lands.

Climate change on Federal lands will be a key agenda item of our Subcommittee and this Congress. I feel strongly that while our public lands are threatened by climate change, they are also critical in finding solutions to combat climate change. As Congress goes about developing climate change legislation, I will work to ensure that there is a role for public lands. I look forward to hearing from our witnesses today, and I will turn to the Ranking Member of the Full Committee, Mr. Hastings, for any comments that he may have. Sir?

[The prepared statement of Mr. Grijalva follows:]

**Statement of The Honorable Raúl M. Grijalva, Chairman,
Subcommittee on National Parks, Forests and Public Lands**

Today our Subcommittee will be conducting an oversight hearing to explore the role of federal lands in combating climate change. This will be the first of a group of hearings our Subcommittee will conduct on climate change. Today's hearing will focus primarily on Forest Service and Bureau of Land Management (BLM) lands, and we expect to schedule a future hearing on National Park Service lands and climate change.

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Climate change not only threatens the world class resources of our federal lands, but also the millions of Americans who depend on and enjoy our federal lands. Today we will be hearing from witnesses about the role of rural public land communities in combating climate change; and we will receive the perspectives of Indian country, the human-powered recreation community, and the hunter-angler community on this topic.

There are two potential climate change solutions that I am particularly interested in exploring today. The first is climate change adaptation. Rick Ridgeway from Freedom to Roam will testify today about connecting habitat in order for wildlife to adapt to the impacts of climate change.

A second solution we will explore is whether some of the key laws under the jurisdiction of the Committee on Natural Resources adequately reflect the reality of climate change. These laws include the National Environmental Policy Act, or NEPA, as well as the various organic acts for the land management agencies. The State of California has moved far beyond the federal government in this area by releasing draft guidance on integrating climate change into the California Environmental Quality Act. Today we will be hearing from Mr. Tony Brunello about California's efforts, and perhaps this can provide good guidance for federal efforts.

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Climate change and federal lands will be a key agenda item for our Subcommittee this Congress. I feel strongly that while our public lands are threatened by climate change, they are also critical in finding solutions to combat climate change. As Congress goes about developing climate change legislation, I will work to ensure that there is a role for federal lands.

I look forward to hearing from all of our witnesses today. I would now like to turn to Ranking Member Bishop for any opening statement he may have.

Mr. HASTINGS. Thank you, Mr. Chairman. I appreciate being here today. I have to say that I am pinch-hitting today. The Ranking Member of this Subcommittee, Mr. Bishop of Utah, has a conflict, and so I am sitting in for him. I will submit my statement for the record.

Mr. GRIJALVA. Thank you.

[The prepared statement of Mr. Hastings follows:]

**Statement of The Honorable Doc Hastings, a Representative in Congress
from the State of Washington**

Mr. Chairman, America has a vast expanse of public lands that are rich in resources. If we use these gifts wisely they can be a bountiful asset as we seek to overcome our current economic problems and increase our security through improved access to domestic supplies of energy, minerals, food, timber and other necessities.

Public lands also will play a significant environmental role as we look for ways to build up our production and transmission of energy from non-polluting sources including solar, hydro, nuclear and wind energy.

One thing is certain: we cannot meet any of our economic, environmental, lifestyle or national security objectives unless we make intelligent choices regarding the use of public land.

There are two major issues I would like to see addressed at this hearing.

First we need to know what new costs will be imposed on the American people by the whole range of restrictions, investments, taxes and cap and trade proposals being talked about to combat climate change.

Second, before we act, we need to understand the magnitude of the effect alternative energy sources—particularly wind and solar—will have on public land. It has been estimated that tens of thousands of square miles would be have to be used to meet a fraction—even one fifth—of our power needs using wind power. Solar power raises similar questions.

Perhaps it is time to apply the precautionary principle to some proposed green governmental actions such as subsidies, regulations, taxes and schemes that purport combat global warming.

Mr. GRIJALVA. Let me now turn to a Member of the Natural Resources Committee, Ms. Lois Capps, for any comments she might have.

STATEMENT OF THE HONORABLE LOIS CAPPS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mrs. CAPPS. Thank you, Mr. Chairman. I will just say thank you for holding this hearing. I believe this is a very important topic for us to be addressing, particularly under the umbrella or the rubric

of climate change. The role of public lands in combating and adapting to climate change is a very real challenge before us.

I want to thank the witnesses who have traveled to be here with us today, and one is in the third panel, who is my constituent, or, at least, from Ventura County, which I represent, and that is Rick Ridgeway. I appreciate his being part of our panel today of witnesses. Rick is the Vice President of Environmental Programs at a very well-known company called Patagonia, which is headquartered in my congressional district and one of America's leading green businesses.

Patagonia helped found Freedom To Roam, a national campaign to create, restore, and protect wildlife corridors. I am proud of the continued expansion and success of Freedom To Roam, and I look forward to your presentation, Mr. Ridgeway.

Mr. Chairman, climate change is a very real and present problem. Human activities have changed the climate of the earth, and I think today's hearing is particularly important for the western states of the United States because many scientists are now saying that the American West will experience the effects of climate change sooner and more intensely than perhaps most other regions.

My home State of California has a lot at stake when it comes to global warming. Our scarce snow and water right now is already being impacted. Crops, such as California wine grapes, are already on the brink, and the warming climate is contributing to longer, wildland fire seasons with more extreme events. We can all attest to that anecdotally, and there is scientific evidence now as well.

We have a world-class tourist industry which has flourished because of our natural beauty, but the impact of climate change on winter snowfalls, agriculture, and our public lands poses a major threat to the economic vitality of my state.

This hearing today is exceedingly important to help us learn what is known and not known about the impacts of global warming, and so I thank you for having this hearing. I look forward to the expertise of our witnesses, and I will yield back.

Mr. GRIJALVA. Thank you. Let me now ask our colleague, Mr. Coffman, if he has any opening comments.

Mr. COFFMAN. Mr. Chairman, I think I will pass until it is time for questions.

Mr. GRIJALVA. Thank you. Mr. Heinrich, any comments?

Mr. HEINRICH. Yes, Chairman. Thank you. You know, I come from the State of New Mexico and have a bit of a history in water management. I was chair of our water utility authority in the metropolitan Albuquerque area for some time, and one of the things that we have seen is a real change in how precipitation, and, particularly winter precipitation, is being impacted by climate change.

Our functional water storage, much like in California in the Sierras, is high in the mountains. It is on Forest Service lands. We are seeing that snows not only run off much more quickly and much more intensely, but, oftentimes, sublimate directly to where it never makes it to the reservoirs in the first place. Many of these impacts have huge ramifications for not only our public lands but our entire population.

So I think this is a timely issue. We have certainly seen changes in our fire regime throughout the Intermountain West, and, par-

ticularly, in New Mexico, that are very concerning to people who live in the urban wildland interface, and being proactive with these issues, I think, is a credit to this Committee, and I am looking forward to hearing what our witnesses today have to say. I yield back, Mr. Chairman.

Mr. GRIJALVA. Thank you. Let me ask Ms. Shea-Porter, do you have any opening comments?

STATEMENT OF THE HONORABLE CAROL SHEA-PORTER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF NEW HAMPSHIRE

Ms. SHEA-PORTER. Yes. Thank you, Mr. Chairman. I am also grateful for this hearing because we have a beautiful White Mountain National Forest in New Hampshire, and there was a hearing, about a year and a half ago, and they talked about some of the impact of the climate change, and we had people coming who had been trappers, who had been hunters, fishermen, and also people who depended on our cold season for snowmobiling and other economically viable activities—skiing, of course, is critical—and what they were all saying was they were seeing such changes.

They were seeing ticks, for example, in January and February, which we never had. They were seeing birds that should not be in our area earlier or later. They were seeing changes in the leaves and many, many signs of changes. The people who produce maple syrup were talking about the impact on their business.

So this is very critical, and it is a very timely issue, and I am grateful that we are having this hearing. Thank you.

Mr. GRIJALVA. Thank you. Ms. Tsongas, any comments?

Ms. TSONGAS. I do welcome your testimony. I have a daughter who was one of the many 12,000 young people who arrived yesterday in town, Power Shift, to address the issue of global warming and climate change.

So this is very timely, and I look forward to your testimony. Thank you.

Mr. GRIJALVA. Thank you. Mr. Kind?

Mr. KIND. Thank you, Mr. Chairman. Mr. Chairman, I have a statement that I would like to submit for the record.

Mr. GRIJALVA. Without objection.

[The prepared statement of Mr. Kind follows:]

Statement of The Honorable Ron Kind, a Representative in Congress from the State of Wisconsin

I would like to start by thanking Chairman Grijalva for calling today's hearing on this very important topic. As the evidence of climate change's effect on wildlife and their habitats continues to mount, the need to plan adequately for these and future impacts grows more and more urgent. This committee began delving into the topic nearly two years ago with a hearing in the Fisheries, Wildlife, and Oceans Subcommittee and subsequent inclusion of funding for planning and adaptation on federal lands during the development of the Energy Independence and Security Act of 2007. Today's hearing, I hope, will be another step forward in our understanding of the implications of climate change for public lands and the various purposes for which they were established, and our developing effective policies for addressing these challenges.

Clearly, as I'm sure we will hear more about today, the challenges to our public lands will be difficult and varied. Federal land units, from the very small to the very large, are already susceptible to events influenced by climactic variability, which include drought, wild fires, impaired air quality, and severe storms. Climate change

may alter the frequency and severity of these kinds of events. Dealing with these changes will require additional financial resources, as well as the flexibility to adapt to changing conditions and evolving priorities.

Many of our National Parks, Wildlife Refuges, National Forests, and Bureau of Land Management lands serve vital ecological roles as sanctuaries where plants and wildlife can thrive without the pressures of excessive human development and interference. This role will become even more important as climactic pressures build. Due to their strong ecological integrity relative to other areas, these lands stand the best chance of withstanding changing conditions, and wildlife will increasingly utilize them as homes or as migration corridors as they seek new habitat.

The prospect of greater reliance on federal lands by wildlife raises the need for better management to protect wildlife and their habitat. Unfortunately, there currently is no statutory or regulatory requirement to manage and maintain wildlife populations during the planning process for the Forest Service or the BLM, which together oversee 457 million acres, or about 65 percent of our public lands. Given the increasing importance of these lands in the future, it is critical that we institute policies that put wildlife on solid footing in our multiple use federal lands. That is why last year I introduced America's Wildlife Heritage Act.

My bill would require the Forest Service and BLM to do their best to maintain viable, or self-sustaining populations of native and desirable non-native species on their lands. This would be implemented through the periodic management planning process and subsequent monitoring activities. Such planning and monitoring would revisit and improve upon former Forest Service rules and expand them to the BLM for the very first time.

The Bush Administration's decision to repeal the Forest Service rules while also pursuing a lopsided focus on resource extraction on public lands has been extremely damaging to wildlife. Most of the evidence for this, however, is anecdotal because the federal government does not require adequate monitoring of most wildlife species, so very little accurate data exists. What is clear is that wildlife management must not be subject to administrative fiat. The America's Wildlife Heritage Act would provide the needed permanency in the form of a forward-looking law that incorporates the most up-to-date scientific principles and enough flexibility to make them workable.

As this Congress moves toward a bold new effort to reduce greenhouse gas emissions in our country, I hope this committee and the agencies under our jurisdiction will be equally bold in their efforts to mitigate and adapt to the changes these gases have caused and will continue to cause. We cannot look to the past and rely on the same tools we have used before; rather, we must look to new ideas to build on what we have learned. I would like to thank all of the witnesses for being here today and say that I look forward to hearing your ideas for how we can move in that direction.

Mr. KIND. I also want to thank you for holding this very important and timely hearing. I think all of us have been looking forward to hearing testimony from some of the experts on the impact of climate change on our public lands and on wildlife, in particular.

It is one of the reasons why, last year, I introduced America's Wildlife Heritage Act. It would require, for the first time, because, right now, there is no statutory or regulatory requirement for the Forest Service or BLM to take in the impact of climate change on wildlife populations on our public lands. We are talking about 457 million acres, close to 65 percent of the public lands with those two entities alone, and there is nothing in the planning process, either statutorily or regulatory, that would require them to measure that impact on wildlife and their habitat.

So, hopefully, I will be able to work with this Committee as we move forward this year on that legislation and hear the testimony from our witnesses here today that can provide us further guidance on what practical steps we can take to deal with such a huge and growing issue.

So thank you again, Mr. Chairman. I look forward to hearing the testimony.

Mr. GRIJALVA. Let me thank my colleagues for their comments and turn to our first panel. I will begin with Chief Gail Kimbell, Forest Service, Department of Agriculture. Welcome again, and we look forward to your comments and testimony. Please.

**STATEMENT OF GAIL KIMBELL, CHIEF, FOREST SERVICE,
U.S. DEPARTMENT OF AGRICULTURE**

Ms. KIMBELL. Thank you, Mr. Chairman. Mr. Chairman and Members of the Subcommittee, thank you for inviting me here today to discuss the very important role that national forests and national grasslands play in addressing climate change.

I am accompanied today by Dr. David Cleaves, who is our acting deputy chief for Research and Development.

I would ask that my full statement be read into the record—

Mr. GRIJALVA. Without objection.

Ms. KIMBELL [continuing]. Thank you—and I will summarize my statement.

We have before us significant challenges and opportunities in managing our nearly 200 million acres of national forests and grasslands in a changing climate. Decisions being made today by policymakers and resource managers have implications through this century and beyond. History will judge the leaders of our age, including my own leadership, as chief forester, by how well we respond to this challenge.

Our national forests and grasslands provide a wide spectrum of ecosystem services that are so very important to our society. They include clean water, clean air, outdoor recreation, fish and wildlife habitat, and forest products. They also include natural resource-based jobs, renewable energy, and carbon sequestration.

However, observations show that climate change is currently impacting the nation's forests and grassland ecosystems in significant ways and, likewise, their ability to provide those ecosystem services.

The mission of the Forest Service is to sustain the health, diversity, and productivity of the nation's forests and grasslands for present and future generations. Recognizing the changing context of our environment, we have developed a Strategic Framework for Responding to Climate Change. The Strategic Framework lays out seven key goals to help us set priorities and make informed decisions for sustaining forests and grasslands. I will focus on the first three of these goals: science, mitigation, and adaptation.

The Forest Service has over 100 years of research and investigation that provide a firm, scientific foundation for our understanding of forests and grasslands and their management. Climate change has changed many assumptions.

We have over 20 years of focused climate change research and over 30 years of air pollution effects research. Thirteen Forest Service scientists shared in the 2007 Nobel Peace Prize as part of the Intergovernmental Panel on Climate Change.

The Forest Service and university and private sector research partners provide an evolving science and technology base for use in managing national forests and grasslands. We use that science in adaptation and mitigation to enhance the ability of the national forests to adapt to the stresses of climate change and to provide

clean water, clean air, and other ecosystem services. Some ecosystems adapt rapidly enough to maintain productivity in the face of climate change. However, climate change impacts other forest types more significantly and exceeds their capacity to adapt.

Managers and policymakers need to be nimble to use new science to adapt to changing conditions. The scope of climate change and its impacts are not always easy to predict. Dealing with risks and uncertainties introduced by climate change is becoming a more prominent part of every district ranger's and every forest supervisor's decision process.

In some cases, failing to take management action can result in allowing catastrophic disruption to an ecosystem and its ability to provide for the things we have come to expect from our public lands: clean water, clean air.

Each year, the Forest Service treats millions of acres of national forests to make them more resistant and resilient in the face of intense wildfire activity, insect and disease, tropical storms, and flooding. This same work helps to make these same lands more resilient and capable of sequestering more carbon.

The Forest Service is working to identify different ways to utilize wood fiber and small-diameter material. When woody materials are removed in forest-restoration projects or any of our projects, it not only reduces the risk of damage from wildfire and other disturbances; it provides a source of cellulose for bioenergy or for other wood products and decreases emissions from forest fires. This work provides jobs, green jobs, and can contribute to the long-term economic health of rural communities.

Ultimately, the issue that might bring people to understanding the importance of the health of their national forest ecosystems is water. In the West, 60 percent of municipal water originates on national forests. It is critical that those forest soils, those forest stands, the hydrologic systems, be able to function in the way they were designed to deliver clean and abundant water to streams and rivers for later use by not only the plants and animals that depend on them along the way but the ever-growing human population.

Water is already a scarce commodity in many places across the United States, and the health of our forests is a critical consideration of how to manage in an era of climate change.

Our national forests play a vital role in helping our nation respond to the challenges of a changing climate. The Forest Service is working to improve the health and sustainability of the national forests, which, in turn, will help these ecosystems adapt to the effects of climate change and permit them to absorb great quantities of carbon from the atmosphere.

Thank you for the opportunity to discuss these issues with the Subcommittee. I will be happy to answer any questions you may have.

[The prepared statement of Ms. Kimbell follows:]

**Statement of Abigail Kimbell, Chief, Forest Service,
U.S. Department of Agriculture**

Mr. Chairman and members of the Subcommittee, thank you for inviting me today to discuss the important role national forests and grasslands play in addressing climate change. Healthy, resilient watersheds represent one of the best insurance policies we have in a changing climate. I will focus my remarks on the science-

based management approaches we are employing to enhance the capacity of our national forests and grasslands to adapt to the effects and mitigate the impacts of climate change.

Forest Service Strategic Framework for Responding to Climate Change

Our national forests and grasslands provide a wide spectrum of ecosystem services on which society relies, including clean water, scenic beauty, outdoor recreation, fish and wildlife habitat, natural resource-based jobs, forest products, renewable energy, and carbon sequestration. However, observations show that climate change is currently impacting the nation's ecosystems and services in significant ways and those alterations are very likely to accelerate in the future, in some cases dramatically.¹

The Forest Service's mission is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. To improve our ability to carry out our mission in a changing climate, the Forest Service developed a Strategic Framework for Responding to Climate Change.

The Strategic Framework identified seven key goals to help us set priorities and make informed decisions for sustaining forest and grassland resources:

Science—Advance our understanding of climate change.

Adaptation—Enhance the capacity of forests and grasslands to adjust to the impacts of climate change.

Mitigation—Promote the management of forests and grasslands to reduce the build-up of greenhouse gases.

Policy—Integrate climate change considerations as appropriate into Forest Service policies, program guidance, and communications.

Sustainable Operations—Reduce the environmental footprint of our operations and facilities.

Education—Advance awareness and understanding.

Alliances—Establish, enhance, and retain strong alliances and partnerships.

These interrelated goals can assist our thinking in how we accomplish our work on National Forest System lands in the face of changing environmental, social, and economic conditions. To achieve these goals, the Forest Service will work collaboratively with the public and a broad range of agencies and partners. We recognize these goals will not be realized immediately. However, we plan to make our goals a reality over time through the ongoing implementation of actions to address climate change.

I highlight below our efforts on three Strategic Framework goals directly related to federal lands and climate change: Science, Adaptation, and Mitigation.

Science

Science that advances our understanding of the environmental, economic, and social implications of how climate change impacts forests and grasslands is essential for scientists, managers and policymakers. There is a wide range of existing science that needs to be translated into land management applications, tools and information. In addition, citizens knowledgeable about climate change and its impacts on ecosystems will be better prepared to participate in decisions and actions affecting their national forests and grasslands.

Climate change presents significant challenges to sustainable management of National Forest System lands. Decisions being made today by policymakers and resource managers will have implications through the next century. Recent reports from the U.S. Climate Change Science Program (CCSP) and the Intergovernmental Panel on Climate Change (IPCC) highlight the impacts of climate change on forests and grasslands. These impacts include changes in precipitation and water availability, shifts in plant and animal distribution, and longer, warmer growing seasons. In 2008, the CCSP released a Synthesis and Assessment Report on the Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity.²

The report found that:

- Climate change has very likely increased the number and frequency of forest fires and insect outbreaks in the Interior West (Colorado and the Great Basin), the Southwest, and Alaska, and will continue to do so.

¹CCSP. May 2008. Synthesis and Assessment Product 4.3 (SAP 4.3): The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. P. Backlund, A. Janetos, and D. Schimel, lead authors. A report by the U.S. Climate Change Science Program (CCSP). Abstract.

²Id., p. 118.

- Rising CO₂ will very likely increase photosynthesis for forests, but this increase will likely only enhance wood production in young forests on fertile soils.
- Nitrogen deposition and warmer temperatures have very likely increased forest growth where adequate water is available and will continue to do so in the near future.
- The combined effects of rising temperatures and CO₂, nitrogen deposition, ozone, and forest disturbance on soil processes and soil carbon storage remain unclear.
- Projected increases in temperature and a lengthening of the growing season will likely extend forage production into late fall and early spring, thereby decreasing need for winter-season forage reserves.
- Climate-change-induced shifts in plant species are already under way in rangelands. Establishment of perennial herbaceous species is reducing soil water availability early in the growing season.

The Forest Service has a long history of researching and tracking many aspects of national forest and grassland ecosystems. We have over two decades of focused climate research, three decades of air pollution research, and experience in scientific assessments that provide a firm scientific foundation for addressing the challenges of managing these ecosystems relative to climate change. Over the years, nearly 125 Forest Service scientists have published climate change research reports and peer-reviewed publications. Thirteen Forest Service scientists were involved in the climate change work of the IPCC that shared in the 2007 Nobel Peace Prize. In addition, the Forest Service and its research partners in the university and private sectors have established a strong science base for informing management practices under a wide range of stressors and management objectives. This science base is being blended with newer findings to provide an evolving science and technology base for use in managing national forests and grasslands in a changing climate.

The Forest Service recently completed the Global Change Research Strategy for 2009-2019. The Strategy is aimed at providing science related to climate change for land managers, policymakers, scientists, and citizens. Our research will focus on adaptation, mitigation, decision support, and science delivery with support from research from other areas such as land use change, interactions between fire and fuels management, carbon cycles, ecosystem management, insects and disease, water, air, soils, wildlife, and social and economic sciences.

The Forest Inventory and Analysis Program has tracked changes in the extent, health, and productivity of forests since the 1930s. In the early 1990s, additional forest health indicators were added to the program and this data can be used over the long term to detect changes in forests at regional and national levels. In addition, the nationwide network of federal experimental forests and ranges provides up to 100 years of data on climate, hydrology, soil productivity, and silvicultural treatments from selected locations representing all the major forest types in the United States. Further scientific support comes from partnerships with universities, federal and state agencies, non-governmental organizations, and the forest industry.

The challenge is to translate this science into information, tools, and technologies that people can use. In addition, we have important science gaps that need to be addressed. Climate models lack the ability to provide projections at the detailed scale that is most useful to land managers and local and regional planners. We lack critical information to determine the stresses of a warming climate and carbon dioxide on plant growth. We need more science about the timing, scale, and location of climate change impacts. Our scientists are looking for better ways of forecasting how terrestrial ecosystems will change in response to a changing climate and how the changes will affect animals and plants that depend on these ecosystems. The Strategic Framework, the Research Strategy and the USDA science strategy recognize these gaps, and the Forest Service is working with USDA and other federal agencies and partners to address them.

Adaptation

The goal of climate change adaptation for forests and grasslands is to enhance their ability to adapt to the environmental stresses of climate change, which will help to ensure their ability to serve as fully functioning ecosystems that provide a broad range of ecosystem services. The ability to adjust to climate change is critical because of its expected effects.

Even under the most optimistic carbon dioxide emission scenarios, important changes in sea level, regional and super-regional temperatures, and precipitation patterns will have profound effects. Management of water resources will become more challenging. Increased evidence of disturbances such as forest fires, insect outbreaks, severe storms, and drought will command public attention and place increasing demands on management resources. Ecosystems are likely to be pushed in-

creasingly into alternate states with possible breakdown of traditional species relationships, such as pollinator/plant and predator/prey interactions, adding additional stresses and potential for system failures.³

Some forest systems may experience near-term productivity increases, but over the long term, many such systems are likely to experience overall decreases in productivity that could result in economic losses, diminished ecosystems services, and the need for new, and in many cases significant, changes to management regimes.⁴

Managers and policymakers will need to be nimble in using new information to adapt to changing conditions because the scope of climate change and its impacts on ecosystems are difficult to predict. In addition, dealing with risks and uncertainties introduced or made worse by climate change will need to be a more prominent part of our management decision processes. In some cases, failing to take management actions will result in significant disruptions to ecosystems, so we must maintain as many options as possible now and in the future for handling unexpected events and conditions.

The primary focus of climate change efforts on National Forest System lands is to facilitate the adaptation of ecosystems to the effects of these changes. Each year, we manage millions of acres of National Forest System land to make forests and grasslands more resistant to wildland fires, insects and diseases, and more resilient to major disturbances such as intense wildfires, tropical storms, and floods. For example, we conduct prescribed burning and thin dense stands to reduce competition, alter species composition, reduce fuels, and improve forest health. These same treatments help our national forests and the species that depend on them adapt to the stresses associated with climate change.

Water is one of the most critical ecosystem services provided by forests and grasslands. Water quality, quantity, and the timing of water flow have important environmental, social, and economic consequences. Forests in the United States provide 53% of the Nation's drinking water to more than 180 million people, with 66 million relying directly on National Forest System lands as their water source. Plants, animals, natural and managed ecosystems, and human settlements are susceptible to variations in the storage, fluxes, and quality of water, all of which are sensitive to climate change. Precipitation, streamflow, and stream temperatures are increasing in most of the continental United States. The western United States is experiencing reduced snowpack and earlier peaks in spring runoff, and we are seeing increased drought severity and duration in the western and southwestern United States.⁵ Clearly, we need effective approaches to address these changes, and we are developing a water strategy to address these issues.

More extensive application of these efforts is vital for adaptation of national forests and grasslands, and will need to be part of future research, planning and management actions. To accelerate our learning and understanding, we are practicing science-based adaptive management, an approach that promotes learning through doing. This approach involves actively making decisions and monitoring results to improve our understanding about the complex systems we manage.

Some management actions may need to be expanded, such as planting a more diverse species mix in reforestation efforts that may be better adapted to future climate projections. New management strategies may be useful, such as assisted migration of species and solutions to moderate extreme stream flows. Specific techniques need to be continually developed, tested and evaluated. Monitoring the effectiveness of our actions is a critically important component of this adaptive adjustment process.

Mitigation

Adaptation and mitigation activities are inherently interrelated. The goal of climate change mitigation for forests and grasslands is to reduce the buildup of greenhouse gases by removing carbon from the atmosphere while sustaining these ecosystems. To significantly reduce its greenhouse gas emissions, the United States will need to implement a variety of mitigation strategies, including sequestering more carbon in forests, grasslands, wetlands, soils, and wood products, planting trees, implementing carbon capture and storage from point sources, and conserving energy through multiple options, including product substitution and use of alternative fuels. A wide variety of strategies can cumulatively contribute to a significant decrease in emissions.

Net carbon uptake by terrestrial ecosystems in the United States, coupled with storage in wood products and landfills, currently offsets about 12 percent of United

³Id., Abstract.

⁴Id., Abstract.

⁵Id. Executive Summary.

States greenhouse gas emissions from fossil fuel combustion and cement production.⁶ Management of forests and grasslands to enhance terrestrial carbon storage, including planting trees and avoiding forest conversion, has considerable potential as an important component of the global capacity to mitigate effects of fossil fuel emissions.

The long-term ability of forests to sequester carbon depends in part on their resilience. Mitigation is actually dependent on how successful we are in keeping forests well-adapted to the changing climate we are trying to remedy. The interplay between mitigation and adaptation can result in delicate balances and difficult trade-offs in our decision-making.

Active management may increase the resiliency of forests and arid lands to respond to climate change. Forest thinning can reduce fire intensity, increase drought tolerance and reduce susceptibility to insect attack. Grazing management and control of invasive species can promote vegetation cover, reduce fire risk, and reduce erosion.⁷ These management practices, designed to restore ecosystem health, may in the near-term reduce total stored carbon below current levels. However, in the long-term the overall capacity of these ecosystems to sequester carbon can be enhanced.

As one of the mitigation strategies, the Forest Service is looking at ways to use smaller diameter woody biomass from overcrowded forests. Biomass removal through forest restoration projects reduces the risk of damage from wildfires and other disturbances and provides a source of cellulose for bio-energy and wood products. The removed biomass also decreases the net effective emissions from disturbance events, offsets fossil fuel emissions, and increases long-term carbon storage. The Forest Service Bioenergy and Bio-based Products Strategic Direction was recently completed and is aimed at providing science to analyze and inform policy and develop a variety of tools useful for landowners and land managers. We are working to provide the science and technology to effectively utilize this type of biomass.

The implementation of restoration activities and increases in renewable energy products and bio-fuels can provide jobs for economically depressed areas with high unemployment and contribute to the long-term economic stability of rural forest communities. Sustainable forest management can provide woody biomass materials that could be used in the future production of renewable energy which may reduce greenhouse gas emissions.

The 2007 Energy Act amended the Renewable Fuel Standards to increase annual amounts of transportation fuel required to be obtained from renewable fuels. The Clean Air Act defines renewable fuels as transportation fuel produced from renewable biomass. The 2007 Energy Act's definition of renewable biomass excludes materials from federal lands except those obtained from the immediate vicinity of buildings and other areas regularly occupied by people, or public infrastructure, at risk of wildfire. We continue our analyses of these and other provisions of these laws, and are in the process of developing policy considerations to utilize woody biomass from federal lands through improvement in infrastructure to process woody biomass, better the economic utility of this biomass as a source of renewable energy, and enhance cost-effective forest restoration treatments that improve forest health and reduce risk of wildfire.

Conclusion

The changing climate is shifting precipitation patterns, vegetation and species distribution, and disturbance patterns, none of which respect administrative boundaries. We are taking science-based adaptive management approaches today to improve the health and sustainability of our national forests and grasslands, which in turn will help these ecosystems adapt to the effects of climate change and mitigate the amount of carbon in the atmosphere. Private forests and rangelands also have a very significant role to play in combating climate change. We are working with partners to adapt our forest and rangeland management programs to anticipate the effects of climate change and mitigate the potential impacts across all ownerships.

Thank you for the opportunity to discuss these issues with the Subcommittee. I would be happy to answer any questions you may have.

Mr. GRIJALVA. Thank you, Chief.

⁶US EPA. April 2008. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. USEPA #430-R-08-005

⁷CCSP. May 2008. SAP 4.3. p. 78.

Let me ask Mr. Thomas Armstrong, Senior Advisor for Global Change Program, U.S. Geological Survey, Department of the Interior. Sir, welcome.

**STATEMENT OF THOMAS R. ARMSTRONG, SENIOR ADVISOR
FOR GLOBAL CHANGE PROGRAM, U.S. GEOLOGICAL SURVEY,
U.S. DEPARTMENT OF THE INTERIOR**

Mr. ARMSTRONG. Thank you. Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to participate on behalf of the Department of the Interior in today's hearing on combating climate change and the role of Federal lands.

My name is Tom Armstrong, and I am the Senior Advisor for Global Change Programs at the U.S. Geological Survey. I also represent the USGS and the Department of the Interior as a principal member of the U.S. Climate Change Science program.

Perhaps no subject relevant to public resource managers is as complex and challenging as global climate change. DOI is focusing its resources on better understanding the impacts related to climate change and helping to identify potential adaptation strategies for managing our natural resources and vital ecosystems in the face of these changes.

Let me give you some specific examples of climate-change-related impacts on DOI lands, waters, and other resources.

The Bureau of Land Management is a steward of the national system of public lands: 258 million acres of surface lands and 700 million acres of subsurface Federal mineral estate, encompassing climate-sensitive arctic tundra, coastal forests, and the vast mountain deserts, and rangelands of the American West. They provide water resources, wildlife habitat, recreation opportunities, forest products, livestock forage, and mineral and energy resources.

The National Park Service units represent a wide range of ecosystems scattered across the Nation that present a tremendous opportunity to observe the effects of climate change on resource conditions that scientists and managers have documented over decades.

Begun almost nine years ago, the National Park Service Natural Resource Challenge Initiative has funded parks across the Nation to conduct inventories and initiate climate-relevant, viable science monitoring of national resources under the NPS's jurisdiction. This information has provided timely examples of the effects of climate change now visible in many of the nation's national parks.

The U.S. Fish and Wildlife Service biologists working on the ground are observing changes in many of our natural systems as well. These changes are more acutely evident in arctic ecosystems, where observations include wetland drainage, earlier green-up of arctic vegetation, and changes in the hydrology of glacially fed streams.

Increased arctic temperatures have also contributed to earlier onset of snowmelt and the lengthening of the melting season, resulting in decreased total ice cover at summer's end.

Climate change in the arctic will continue to affect the habitats of ice-dependent species, such as the polar bear and the walrus. Now, let me briefly discuss how we are focusing our resources to combat climate change and its impacts.

The USGS is collecting, monitoring, analyzing, and providing scientific information about natural resources conditions, issues, and problems for use by decisionmakers in the Department, at all levels of government, and by the general public. This information, coupled with its effective dissemination, is the key to combating the effects of climate change.

To this end, the USGS has created a climate effects network, an early warning system on the effects of climate change, as well as the National Climate Change and Wildlife Science Center for understanding fish, wildlife, and related habitat response to changing climate.

The efforts of USGS will result in new knowledge and tools to support land and resource managers, citizens, and other stakeholders in managing and making decisions that will be cost-effective, provide for more resilient ecosystems and watersheds, and, ultimately, safer communities.

The Administration recognizes the important role science plays in understanding and addressing the impacts of climate change. The President's 2010 budget blueprint includes more than \$130 million in additional funding for the Department to monitor, adaptively manage, and assess the impacts of climate change on the nation's lands, fish, waters, and wildlife. While more details relating to the Department's budget will become available as the planning process continues, this is an important endorsement of the need for scientific analyses to understand and address these changes.

The Department of the Interior has a natural leadership role among Federal agencies addressing climate change on Federal lands and can bring all of its resource management, scientific, and information capabilities to bear in accomplishing this goal.

All of the Department's land-managing bureaus have taken actions to identify and address the impacts of climate change, but the complexity of the problem and the scope of the issues demonstrates that more work is, indeed, necessary.

As Secretary Salazar assembles his team, the Department will work with its counterparts in this Administration to address the important issues.

Thank you, Mr. Chairman, for the opportunity to present my testimony, and I will be pleased to answer any questions you and the other Members may have for me.

[The prepared statement of Mr. Armstrong follows:]

Statement of Dr. Thomas R. Armstrong, Senior Advisor for Global Change Programs, U.S. Geological Survey, U.S. Department of the Interior

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to participate on behalf of the Department of the Interior in today's hearing on combating climate change and the role of Federal lands. My name is Thomas R. Armstrong, and I am the senior advisor for Global Change Programs at the U.S. Geological Survey (USGS). I also represent the USGS and the Department as a Principal member of the U.S. Climate Change Science Program (CCSP).

The Department has a natural leadership role among Federal agencies addressing climate change on Federal lands and can bring all of its resource management expertise, capacity for alternative energy development, and scientific and information capabilities to bear in accomplishing that goal. As Secretary Salazar assembles his team, the Department will work with its counterparts in the Administration to address these important issues.

My statement today largely focuses on the USGS's role with regard to climate change research and science, focusing on climate impacts on our natural resources,

including water, land, and wildlife. In addition, Section 711 of the Energy Independence and Security Act (P.L. 110-140), enacted into law in December 2007, authorized the Secretary of the Interior, acting through the Director of the USGS, to develop an assessment methodology and conduct a national assessment of geological storage capacity in collaboration with other relevant agencies. The USGS's ability to collect, monitor, and analyze relevant data allows it to provide scientific information about natural resource conditions, issues, and problems to decision-makers in the Department, at all levels of government, and the general public. This information—baseline scientific information, trends detection, modeling and forecasting, together with the effective dissemination of information and decision support tools—is key to understanding and addressing climate change and its effects.

The Administration has recognized the important role science plays in understanding and addressing the impacts of climate change. The President's 2010 Budget Blueprint includes more than \$130 million in additional funding for Interior, of which \$40 million is shared with the States to monitor, adaptively manage, and assess the impacts of climate change on the Nation's lands, fish and wildlife. While more details relating to the Department's budget, and these particular activities, will become available as the planning process continues, this is an important endorsement of the need for scientific analyses to understand and address these changes.

My statement also includes summary information on the impacts of changing climate as seen on the ground by the Department's land managing bureaus and the Bureau of Reclamation, as well as a brief look at adaptation and mitigation issues facing the bureaus as they carry out their missions. I am also joined by representatives from the Bureau of Land Management, the National Park Service, and the U.S. Fish and Wildlife Service, who are here to answer any questions you might have with respect to their programs.

Background

Perhaps no subject relevant to public land managers is as complex and challenging as global climate change. The Department of the Interior manages one in every five acres of the U.S. land mass. The bureaus within it operate dams and irrigation facilities that provide water to farmers and manage leases from which one-third of the Nation's domestic energy supplies are produced. Lands and waters under the Department's management jurisdiction account for significant contributions to our alternative energy supply from sources such as biomass, geothermal, solar, and wind power. Our wildlife refuges and national parks provide important wildlife habitat and manage extensive areas of shoreline and important wetlands. In Alaska alone, where the most tangible effects of climate change are being seen in the United States, the Department manages tens of millions of acres of public land, parks, and refuges.

Climate change affects biota, water, ecosystems, cultures, and economies. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) notes that climate change is expected to affect precipitation patterns, vegetation types and distribution, wildlife habitat and behavior, fire frequency, sea levels, the spread of pests and diseases, as well as a broad range of human activities. In order to effectively manage its lands and trust resources, the Department, working within the broader U.S. interagency climate change science framework, has a responsibility to further the scientific understanding of climate change processes and impacts. USGS scientists were contributing authors of the Climate Change Science Program's Synthesis and Assessment Product 4.4: Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources, drawing on their expertise to identify adaptation strategies for National Parks and National Wildlife Refuges. The USGS conducts scientific research to understand the likely consequences of climate change, especially by studying how climate has changed in the past and using this historical record to forecast responses to shifting climate conditions in the future; distinguishing between natural and human-influenced changes; and recognizing ecological and physical responses to changes in climate. These strengths allow USGS to play a critical role in conducting climate change science across the Nation's terrestrial, freshwater, and coastal systems—within and beyond Federal lands—and in providing objective science to assist decision-makers.

USGS Climate Change Science

Using these integrated assets, the USGS is creating a Climate Effects Network, an early warning system on the effects of climate change. USGS is also developing a National Climate Change and Wildlife Science Center for understanding fish and wildlife responses to changing climate and for testing and validating related adaptation decisions by land managers and other stakeholders. The efforts of USGS will

result in new knowledge and tools to support land and resource managers, citizens, and other stakeholders in making decisions that will be cost effective, provide more resilient ecosystems and watersheds, and safer communities.

The USGS provides on-the-ground scientific information from its numerous observation and monitoring networks and research activities. These observations and related research efforts are important components for building climate models, especially those that deal with the impacts of climate change to terrestrial, freshwater, and marine ecosystems. The ability to provide ground-truthing across multiple scientific disciplines in a wide variety of spatial and temporal scales enables the USGS to play a key role within the climate science community as we, and others in the international community, strive to develop adaptation and mitigation measures.

Regarding climate impacts on Federal lands, USGS findings and data provide critical information to decision-makers regarding many important climate-related issues, such as:

- Proliferation of invasive species and impacts on biodiversity, habitat, and ecosystems. The USGS is conducting several major studies throughout the United States looking at the evolution of forest and rangeland communities as a response to warming climate and changes in precipitation. The U.S. Forest Service, several land resource bureaus of the Department, and numerous State resource agencies are important stakeholders.
- Current and future trends of climate warming in the Arctic and resultant permafrost degradation and impacts on energy and transportation. The USGS is conducting several coordinated studies on the North Slope and Yukon Basin of Alaska. Emphasis is on permafrost and climate effects monitoring and related ecological and socio-economic changes. This work is a partnership with the U.S. Forest Service, the U.S. Fish and Wildlife Service, the Bureau of Land Management, the National Park Service, the University of Alaska, Alaska State agencies, and various Native communities.
- Coastal erosion in Alaska. A recent study, led by the USGS, finds that average annual erosion rates along part of the Beaufort Sea climbed from historical levels of about 20 feet per year between the mid-1950s and late-1970s, to 28 feet per year between the late-1970s and early 2000s, to a rate of 45 feet per year between 2002 and 2007. While the findings could represent a short-term episode, the study, published in the current issue of *Geophysical Research Letters*, could represent the future pattern of coastline erosion in the Arctic.
- Consequences of abrupt changes in climate including sea-level rise and impacts to low-lying coastal communities. USGS projects include two Priority Ecosystem Studies in the Chesapeake Bay and the Everglades. The USGS is collaborating with many partners, including the Army Corps of Engineers, the U.S. Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA) and the land management bureaus within the Department.
- Impacts of climate change on land use and landscape change. In partnership with the National Aeronautics and Space Administration and NOAA, the USGS is involved in a variety of activities that are critical to understanding the impacts of climate change on public lands. These include monitoring of coastal zone topography and bathymetry; the production and distribution of national topography data; and improving our knowledge of topographic surface change through Landsat, and light-imaging detection and ranging (LIDAR) and radar imaging of the U.S. national land surface.
- Future availability of water for people and ecosystems. Specific projects underway include hydroclimatology studies in the Pacific Northwest and arid Southwest to assess current and future changes in water availability for these regions, and to identify associated impacts on dam and reservoir management strategies. The Bureau of Reclamation and several State water agencies are principal stakeholders for this work.

Scientific findings related to climate change must be effectively conveyed and delivered in a timely manner so that decision-makers are informed by the most relevant, up to date, objective information possible. Furthermore, scientists must provide this information with accurate estimates of uncertainty so that conclusions and recommendations drawn from scientific studies can be properly evaluated. The CCSP, of which both the USGS and the Department are members, is actively involved in developing a more effective decision support strategy for all interested stakeholders.

Although science has come far in understanding the impacts of climate change on people and ecosystems, many significant challenges and unique opportunities to better understand the long-term climate future for our planet remain. These include:

- Developing a holistic, earth-systems science approach to help communities and natural resource managers prepare for climate change impacts;

- Developing a better understanding of how the earth and its physical and biological processes interact, and with this understanding respond to climate change over the short-term and well into the future;
- Forecasting climate-related impacts for physical and biological systems;
- Forecasting precipitation changes as a consequence of changing climate;
- Determining how global warming may alter the frequency, intensity, and paths of strong storms, including hurricanes, as well as their impacts on coastal communities and natural resources; and;
- Understanding effects of climate change on entire ecosystems.

Included below is a summary of the impacts of changing climate on our bureau assets and resources and a brief look at adaptation and mitigation issues that the bureaus are currently facing. As can be seen, all the Department's land managing bureaus have taken some actions to identify and address the impacts of climate change, but the complexity of the problem and the scope of the issues to be addressed means more work is necessary.

Bureau of Land Management

The BLM is steward of the National System of Public Lands, 258 million acres of surface lands and 700 million acres of subsurface Federal mineral estate that are tremendously diverse. Encompassing Arctic tundra, coastal forests, and the vast mountains, deserts, and rangelands of the American West, they provide water resources, wildlife habitat, recreation opportunities, forest products, livestock forage, and mineral and energy resources.

The effects of climate change may already be apparent on public lands managed by BLM. One example is the desertification of public lands as a result of an increase in the frequency and duration of drought, which has recently been linked to long-term changes in the climate system. This has been accompanied by reductions in surface flow and groundwater levels, and a reduction in water availability. Vegetation in some places has converted to more drought hardy species, accompanied by or resulting from the expansion of non-native and other undesirable species. In some instances, species numbers have been reduced and, in affected habitat, some species have been lost. The overall results of these changes are more fragile ecosystems, a greater susceptibility to the outbreak of attacks by parasites and disease, increased vulnerability to wildland fire and erosion, and an overall reduction in carrying capacity. In Alaska, increased melting and other loss of glacial masses is seen and permafrost melting is occurring, resulting in loss of soil stability and increased erosion.

As a bureau, BLM is beginning to address climate change as a comprehensive factor in general management planning, and to identify the effects under cumulative impact analysis in environmental assessments. At this point, however, there is little guidance in dealing with this issue; as knowledge of climate change processes matures, the bureau's ability to address it will evolve and almost certainly improve. The BLM is currently working on refinements to enhance integration of science, planning, and project implementation. The BLM is also working to increase its ability to monitor, assess, predict, and respond to landscape changes over time, and is also continuing and expanding science research partnerships with the USGS, Department of Energy, other agencies, and universities.

The BLM is also implementing programs to address climate change on a broader scale. Maintaining and restoring healthy, resilient ecosystems is crucial to ameliorating and adapting to the effects of climate change. Much has been learned as this effort has evolved. Most importantly, the Bureau has recognized that landscape-scale problems require landscape-scale responses. Effective management must apply science, integrate disciplines, involve partners, coordinate jurisdictions, and link local actions to regional management strategies and priorities. Examples include the Great Basin Restoration Initiative underway in Nevada, Oregon, and Idaho, and the Healthy Forests Initiative, which focuses on restoring forest ecosystems across public lands.

The BLM is providing opportunities for increased production of renewable energy through permitting on public lands of wind, solar and geothermal generation projects—of which there is vast potential—and projects for use of woody biomass resulting from forest management. The BLM's completed programmatic plans estimate that, by 2025, wind energy capacity on public lands could reasonably increase five-fold from current levels. The projected increase for geothermal energy is even greater. Fully 90 percent of the existing and future geothermal resources in the United States are on Federal lands, and geothermal energy capacity could reasonably increase 15-20-fold by 2025. Similarly, solar energy on public lands holds great potential, and BLM is currently completing a programmatic environmental impact statement to assess potential development scenarios for solar energy and to help facilitate the development of solar energy projects on the public lands.

The public lands may also have an important role in efforts to mitigate emissions through terrestrial and geologic carbon sequestration. The capability to capture and store carbon dioxide in geologic formations could have a significant role in mitigating carbon dioxide emissions, which are a key factor in climate change. Geologic carbon sequestration is also considered especially important because it could enable the more climate-friendly use of the Nation's vast coal resources. However, the challenges of geologic carbon sequestration are complex and significant, and many technological, scientific, legal and logistical questions exist. The BLM is working in cooperation with the Department of Energy to assess the feasibility of geologic sequestration, and BLM is currently preparing recommendations regarding the potential administration of geological sequestration projects on public lands.

Finally, BLM is implementing policies and practices that result in reduction of energy and other natural resources used by the bureau, as well as production of pollutants that exacerbate climate change effects.

National Park Service

National park units represent a wide range of ecosystems scattered across the nation that present a tremendous opportunity to observe the effects of climate change on resource conditions that scientists and managers have documented over decades. Begun almost nine years ago, the National Park Service Natural Resources Challenge Initiative has funded parks across the nation to conduct inventories and initiate vital signs monitoring of natural resources under the NPS's jurisdiction. The combination of these sources of information, long-term legacy monitoring data, and new inventories has provided timely examples of the possible effects of climate change now visible in parks.

Based on NPS and other collaborative research, climate change presents significant risks and challenges to national parks. Warming temperatures have caused accelerated melting of mountain glaciers, reduced snowpack, and changes in timing and amount of stream flow. As noted above, these impacts are particularly felt in Alaska, where melting sea ice threatens marine mammals as well as coastal communities, and thawing permafrost is contributing to the loss of buildings, roads, and facilities and disrupting the structural basis of large regions of interior Alaska. Shoreline vulnerability maps for parks, created by the USGS, predict that rising seas will erode beaches and coastlines and submerge wetlands and Native American cultural artifacts at coastal park units. Inundation of coastal estuaries, intertidal zones, and beaches will result in beach loss. Elevated water temperatures are causing coral bleaching and disease, and aggravating water quality problems that lead to harmful algal blooms. Estuaries, which are essentially fish nurseries that filter pollutants and protect the coast from storm surges, will be submerged faster than new sediment can build up. Valuable habitat for eelgrass beds, foraging waterbirds, shorebirds and nearshore fish will be lost. While some impacts are already measurable, the long-range effects of climate disruption on NPS natural and cultural resources, park infrastructure, and visitor experience are not currently known.

Because climate change has been identified as one of highest priorities for the NPS, many actions and activities have been undertaken at parks and within regions. The NPS is now in the process of developing a strategic framework for action that will detail long and short-term actions in three major areas: mitigation, adaptation, and public communication. The NPS has hired a Climate Change Coordinator, created six ad-hoc working groups—Legal & Policy; Planning; Science; Resource Stewardship; Greenhouse Gas Emission & Sustainable Operations, and Communication—to explore key goals and strategic actions that need to be addressed at park, regional, and national levels; and has held a series of regional and interagency workshops to explore climate change impacts and coping strategies and to develop action plans. In conjunction with the Environmental Protection Agency, in 2003 the NPS initiated the Climate Friendly Parks Program to promote sustainable operations in parks and create action plans to reduce greenhouse gas emissions, with almost 50 parks now participating. The NPS also created the Environmental Management Systems Programs with the goal of sustainable park operations and reduction of environmental impacts. Finally, NPS formed a service-wide Climate Change Response Steering Committee to foster communications, provide recommendations, and serve as an advisory body to NPS leadership; the Committee adopted the NPS Ocean Park Stewardship Action Plan in 2006 to guide actions to reduce ocean-related climate change impacts.

Looking to the future, the NPS will seek opportunities to capitalize on, and expand, the potential that units of the national park system provide for understanding long-term effects of climate change, testing innovative measures for adapting to climate change, and informing the public about climate-change-caused effects on nat-

ural and cultural resources and on the ability for visitors to experience enjoyable park visits.

U.S. Fish and Wildlife Service

The Service is a field-based organization, and biologists working on-the-ground are observing changes in many of our natural systems. Like the other land managing bureaus, these changes are more acutely evident in Arctic ecosystems where, in addition to the previously mentioned changes, observations include wetland drainage earlier “green-up” of Arctic vegetation, and changes in the hydrology of glacially-fed streams. Increased Arctic temperatures have also contributed to the earlier onset of snow melt and the lengthening of the melting season, resulting in decreased total ice cover at summer’s end. Climate change in the Arctic will continue to affect the habitats of ice-dependent species such as polar bear and walrus.

Like the polar regions, the Northwest and the Mountain-West have been experiencing reductions in annual snowpack, with USGS estimating that climate changes over the last 50 years in these areas have led to as much as a 17 percent decline in annual winter snowpack. The result has been a decreased recharge of ground water systems, increased stress to public water systems, changes in the timing of river ice-outs, and reduced river flows that affect temperature, depth, and other characteristics of spawning environments for fish such as Pacific salmon. Snowpack declines also have been accompanied by earlier annual peaks in river run-off, as documented in stream gage monitoring and analyses across the lower 48 States and throughout Alaska. As snow pack melts earlier throughout the western United States, reservoirs designed upon 20th century hydrology may not be able to adequately store the runoff. Predictions of less frequent, but more intense, summer storms may exacerbate storage and supply concerns.

Land managers face the growing reality that these recent observations may not be part of annual or even decadal change in weather patterns, but are possibly linked to a long-term change in the climate system. If this is the case, the implications for wildlife and fisheries management are substantial and will require extensive changes in the design and placement of projects to store water, protect and restore habitats, and manage populations.

Service biologists are also noting changes in abundance and distribution of species, including the expansion of pests and invasive species. Expansion of the mountain pine beetle into higher latitudes and elevations—areas once too cold to support it—is well correlated with observed temperature changes. This range expansion is increasingly impacting forest habitats, not just killing trees, but making these landscapes more susceptible to catastrophic wildfires and creating the potential to drive fundamental shifts in ecosystem function and structure. While some species will adapt successfully, some will not. Species most at risk are those that are unable to generalize or adapt. Long-distance migrants and birds with limited geographical ranges, for instance, may not be able to adjust to the changes caused by rising temperatures. Species at the end of geographical or elevational gradients will have difficulty adapting because they have nowhere to which they can migrate. Increased competition for habitat and the lack of suitable or available food in new locations would mean that a shift poleward may change the size of bird populations and composition of bird communities adapting to climate change.

Other significant changes associated with increased warming include rising sea levels and water temperatures that pose threats to marine habitats, coastal wetlands, and estuaries which are part of more than 160 National Wildlife Refuges the Service manages along the nation’s coastline. Pea Island National Wildlife Refuge, part of the Alligator River National Wildlife Refuge Complex along the North Carolina coast, is losing ground annually to the Atlantic Ocean. The projected rise in sea level over the next 50 to 100 years will likely transform large expanses of marsh to open water, forest to marsh, and complicate habitat conservation for species such as the Federally endangered red wolf and many other species of birds and wildlife.

While the primary factor causing incidents of harmful algal blooms in the Gulf of Mexico is nutrient runoff, increased ocean temperatures are also accelerating the intensity of these blooms, or “red tides.” These increased incidents can cause significant fish kills, contaminate shellfish and, when inhaled, can create severe respiratory irritation to human. Increased ocean temperatures also contribute to more frequent and more intense events of coral bleaching and disease which can stress and kill corals. With the rise of atmospheric carbon dioxide levels, our oceans are becoming more acidic. As oceans absorb more carbon dioxide, the availability of carbonate ions is reduced. Reef-building organisms and shellfish require an abundance of carbonate ions to build their skeletons and shells.

The Service has established an impressive track record of adapting and mitigating strategies, including pioneering partnerships in habitat restoration and terrestrial

sequestration. The Service is also beginning to address the potential for significant sea level rise. A comprehensive modeling effort using what is called the Sea Level Affecting Marshes Model (SLAMM) has been undertaken to determine the potential effects of sea-level rise on coastal National Wildlife Refuges. The SLAMM model simulates the dominant processes involved in wetland conversions and shoreline modifications during long-term sea level rise. SLAMM results will be crucial elements in developing refuge and landscape-scale adaptation strategies and in revising refuge comprehensive conservation plans.

The Service is working with other agencies, States, and partners to understand developments as quickly as possible and develop the capacity to respond to impacts on lands it manages and trust species under its jurisdiction.

Bureau of Reclamation

The Bureau of Reclamation is the largest wholesaler of water in the country, bringing water to more than 31 million people and providing one out of five Western farmers with irrigation water for 10 million acres of farmland. Reclamation is also the second largest producer of hydroelectric power in the western United States, with 58 powerplants annually providing more than 40 billion kilowatt hours—enough electricity to serve 6 million homes.

There is extensive study and discussion within the scientific community about the potential impacts of a changing climate on western water resources. For example, in 2007, a report from the National Academies of Science on Colorado River Basin Water Management concluded that “higher temperatures will result in less upper basin precipitation falling as snow, increased evaporative losses, and will shift the timing of peak spring snowmelt to earlier in the year.” The need to increase the predictive capabilities of climate change models was discussed earlier in this statement. As those improvements occur, Reclamation will be looking to where and how to incorporate new climate change information.

Fortunately, Reclamation possesses operational flexibility to respond to hydrologic change and fulfill its mission to deliver water and power in the West. Drought, flood, and wide climate variability are all common occurrences in the western United States. Given its mission, Reclamation must manage with this variability in mind. However, solutions and strategies for incorporating climate change science into water project operations is an emerging effort being undertaken by all western water management interests, not just Reclamation. Identifying the information needed will require coordinated participation from all the organizations that can provide expert climate and hydrologic sciences.

Reclamation works with its many partners to better understand and incorporate climate information into western water resource management, including the USGS. The Reclamation Research and Development (R&D) Office is working with climate change experts in the USGS to help define the impact of changes in climate variability and climate change on western water resources.

Conclusion

In conclusion, there is a growing consensus that changes in the natural and human systems related to the effects of climate change must be better understood, monitored and forecasted so that all of the Nation's resources can be effectively managed and protected. The Department's bureaus are in an important position, partnering with USGS, to evaluate and develop responsive strategies for the impacts that we are observing and cataloging on resources in the Arctic, water resources in the southwest, and on the abundance and distribution of wildlife.

Thank you, Mr. Chairman, for the opportunity to present this testimony on behalf of the Department. I will be pleased to answer questions you and other Members of the Subcommittee might have.

Mr. GRIJALVA. Thank you very much.

Mr. Anthony Brunello, Deputy Secretary for Climate Change and Energy, California Natural Resources Agency. Mr. Secretary.

STATEMENT OF ANTHONY BRUNELLO, DEPUTY SECRETARY FOR CLIMATE CHANGE AND ENERGY, CALIFORNIA NATURAL RESOURCES AGENCY, SACRAMENTO, CALIFORNIA

Mr. BRUNELLO. Thank you, Mr. Chairman, distinguished Members. My name is Anthony Brunello. I am the Deputy Secretary for

Climate Change and Energy at the California Natural Resources Agency.

Federal lands account for approximately 43 percent of California's total land ownership and are explicitly linked to our ambitious climate change and energy goals across the state. Of our 32 million acres of forest land, the Federal government manages over 13 million acres that emit and sequester vast amounts of greenhouse gases annually.

National forests in California are estimated to be net carbon sinks throughout the entire year, making our forests a primary contributor to our national net sinks total.

The BLM oversees vast landscapes in California, with enormous solar, wind, and geothermal energy potential, holding the key to powering millions of homes in the West with renewable energy. And the National Park Service manages habitat for many wildlife and aquatic species that could become extinct due to increasing temperatures, shifting precipitation, and rising sea levels.

How the Federal government will require its agencies and projects to account for, mitigate, sequester, and monitor greenhouse gases and how to adapt to future climate impacts should be carefully weighed with their economic, environmental, health, and safety considerations while complementing existing state climate policy efforts.

California has a detailed and aggressive portfolio of regulations and incentives to reduce the state's greenhouse gas emissions, increase its resilience to anticipated climate impacts, and to promote the sustainable development and utilization of renewable energy resources that we hope will match Federal efforts.

In my submitted testimony, there is much more information on our regulations that I discuss there.

For the remainder of my time, I would like to highlight four opportunities for the Subcommittee to continue to provide climate and energy policy leadership on Federal lands, including, first, work to maintain and increase carbon stocks on public lands and, in particular, by reducing catastrophic wildfire.

California's forests are already under threat, as has already been mentioned, from development, wildfire, insects, pests, disease, and now climate change. Wildfires, in particular, are a major driver of forest carbon loss in California and for the nation. Over three million acres of Forest Service land in California suffered wildfire damage between 2000 and 2008, with over 300,000 acres completely deforested.

Climate scientists are predicting that the situation will only worsen as temperatures rise. California has been working closely with the Forest Service, over the last three years and further, to improve our climate-related efforts, but these efforts have been marginally funded and need additional support.

Support should be provided to help reforest areas devastated by wildfire, fund the expansion of the Forest Inventory Assessment, which is absolutely essential to understand and have better accounting for carbon on our national lands, and expand forest fuels treatment on public lands using sustainable harvesting practices in allowing woody biomass to be characterized as a renewable fuel.

This last point is sensitive between the Forest Service, industry, and the NGO community, but a solution is needed to reduce fire risks and to meet our national climate and energy goals.

Second, consider state actions to assess greenhouse gases and environmental impact assessments, such as the California Environmental Quality Act, to inform similar efforts for the National Environmental Act. This includes basic “do’s,” such as counting of projects’ greenhouse gas emissions and mitigating for those emissions, to “do not’s,” such as taking away authority for lead agency discretion.

The third point: Increase public lands’ resilience to future climate impacts, which has already been discussed today. In particular, states need better coordination amongst Federal agencies, and this is key: more and better policy-oriented research and more funding to implement these efforts. The cap-and-trade bill will not stop expected sea level rise, temperature rise, or reduce rainfall over the next century. Adapting to these impacts is a necessity.

The climate-adaptation text of last year’s H.R. 6186 climate legislation introduced by Representative Markey is a good place to start.

The fourth point: Ensure Federal land management agencies have the financing, policies, and authority to quickly and effectively process renewable energy applications in sustainable locations. This would include providing full support for recently created BLM renewable-energy coordination offices that will expedite the permitting of wind, solar, biomass, and geothermal projects, along with needed electrical transmission facilities.

More details of these measures can be found in my submitted testimony.

Thank you for giving me the opportunity, and I look forward to your questions.

[The prepared statement of Mr. Brunello follows:]

Statement of Anthony Brunello, Deputy Secretary for Climate Change and Energy, California Natural Resources Agency

Chairman Grijalva, Ranking Member Bishop, and distinguished members of the Subcommittee; thank you for the opportunity to appear today to offer testimony regarding the role of federal lands in combating climate change in California. My name is Anthony Brunello and I serve as the Deputy Secretary for Climate Change and Energy for the California Natural Resources Agency (CNRA).

Federal lands account for approximately 43% of California’s total land ownership and are explicitly linked to California’s ambitious climate change and energy goals. For example, of the 32 million acres of forestland in California, the U.S. Forest Service (USFS) manages over 13 million acres that emit and sequester vast amounts of greenhouse gases (GHG) annually. Unlike most of the U.S., California forests are estimated to be net carbon sinks throughout the entire year, making California forestland a primary contributor to the large estimated net carbon sink of U.S. forests. The U.S. Bureau of Land Management (BLM) oversees vast landscapes with enormous solar, wind, and geothermal energy potential holding the key to powering millions of homes in California with renewable energy. And the U.S. National Park Service (NPS) manages habitat for many wildlife and aquatic species that could become extinct due to increasing temperatures, shifting precipitation and rising sea levels.

How the federal government will require its agencies and projects to account for, mitigate, sequester, and monitor GHGs, and how to adapt to future climate impacts, should be carefully weighed with their economic, environmental, health and safety considerations, while complementing existing state climate policy state efforts. I hope my testimony provides insight into California’s climate policy context as the Subcommittee develops new climate policies for federal lands.

California Climate Policies Related to Public Lands

California has a detailed and aggressive portfolio of regulations and incentives to reduce the state's GHG emissions, increase its resilience to anticipated climate impacts, and to promote the sustainable development and utilization of renewable energy resources to meet state energy and climate goals. California's central climate policy is the Global Warming Solutions Act (or Assembly Bill 32, AB32) signed by Governor Schwarzenegger in 2006 to reduce state GHG emissions by roughly 28% below 1990 levels by 2020, and by 80% by 2050. This is a mandatory economy-wide target providing broad authority to our state air regulating body, the California Air Resources Board (CARB), to use regulatory and market-based mechanisms, such as a cap and trade system to reach this target.

In December of 2008 CARB adopted the AB32 work plan (referred to as "the Scoping Plan") to reduce an estimated 172 million metric tons of CO₂ equivalent (MMTCO₂E) by 2020, which includes measures related to public lands. Although AB32 is a state law, USFS and BLM were directly engaged with state efforts led by CNRA to meet forestry and renewable energy goals, in particular. For the forestry sector, the Scoping Plan sets a target for the entire state to sequester 5 tons or greater across all lands including federal lands.

Senate Bill 97 (SB97) was passed by the California State Legislature in 2007 requiring the state to provide technical guidance within the California Environmental Quality Act (CEQA) for how individual projects should assess GHG activities from their project activities. The guidelines will be complete by the end of 2009, but current plans require all projects to: provide an analysis of the potential effects of GHGs on the environment; provide a calculation of GHG emissions from direct and indirect sources; determine the significance of potential impacts assessed and supported by substantial evidence; avoid duplicative and costly analysis where it is possible to tier from state or regional efforts; adopt feasible mitigation where there are significant impacts; and allow Statements of Overriding Consideration.

Regarding renewable energy, Governor Schwarzenegger signed Executive Order (EO) S-14-08 in November 2008 requiring California utilities to get 33 percent of their electricity load from renewable energy sources by 2020. This order sets a renewable portfolio standard that leads the nation. A key constraint in reaching this goal is efficiently permitting renewable projects on public lands. The EO requires state agencies to develop a new streamlined review and approval process for renewable energy sites and to cooperate, through an MOU with BLM and the U.S. Fish and Wildlife Service (FWS), to create a streamlined process that will make it easier for wind, solar and geothermal sites to be built in California.

Regarding climate impacts in California, Governor Schwarzenegger signed EO S-13-08 also in November 2008 to enhance the state's management of climate impacts from sea level rise, increased temperatures, shifting precipitation and extreme weather events. The EO initiated California's first statewide climate change adaptation strategy with multiple Agencies and Departments to be complete by June 2009, requested the National Academy of Sciences to assess sea level rise impacts specific to California, and ordered state agencies to plan for sea level rise in designated coastal and floodplain areas for new projects. Given the serious long-term threat of sea level rise and other climate impacts to California's water supply and coastal resources, an adaptation plan is the first step in reducing assets at risk from climate change (largely from wildfire and flooding) that could significantly alter our state's economy, population and natural resources.

RECOMMENDATIONS

There are several opportunities for the Subcommittee to continue to provide climate and energy policy leadership for federal lands. California's recommendations below are based on four general goals including: (1) maintain and increase carbon stocks on public lands (in particular in reducing catastrophic wildfire); (2) increase public land resilience to future climate impacts; (3) ensure federal land management agencies have the financing, policies, and authority to quickly and effectively process renewable energy applications in sustainable locations; (4) and consider state actions to assess GHGs in Environmental Impact Assessments, such as in the California's Environmental Quality Act (CEQA), inform similar efforts for the National Environmental Quality Act (NEPA).

I. Maintain and increase carbon stocks on public lands

California's forests are under threat from development, wildfire, insects, pests, disease and climate change. Wildfire, in particular, is a major driver of forest carbon loss in California, and for the nation. Over 3 million acres of USFS land in California suffered wildfire damage between 2000 and 2008, with over 300 thousand

acres completely deforested. Climate scientists are predicting that the situation will only worsen as temperatures rise.

California has been working closely with USFS Region 5 over the last 3 years to improve carbon accounting in state and federal forest lands, to develop joint forestry GHG emission reduction and forest adaptation projects and plans, and to develop markets for biomass residue from forest thinning (fuel hazard reduction and forest health) and timber harvesting. But, these efforts have been marginally funded and need additional support. We recommend the following specific activities to ensure we are increasing carbon stocks on public lands.

1. Reforest areas that have been devastated by wildfire—As mentioned, over 300,000 acres have been completely destroyed and deforested from fire over the last decade. Restoring and reforesting these lands could require over 30,000 acres per year that could eventually sequester 2-5 tons per acre per year. For the 300,000 acres of planting there is a potential of sequestering 2-8 MMTCO₂E every year. Replanting has the additional benefit of reducing mudslides and promoting habitat restoration.
2. Fund the refinement and expansion of the USFS Forest Inventory Assessment (FIA)—The FIA is essential in developing, tracking, and monitoring any national climate change policy efforts regarding land-use GHG emissions and sequestration. The refinement and expansion of plots in California are essential to demonstrating the contribution of forests to GHG reduction and to ensuring that California forests meet our state climate goals. FIA data will also, assumedly, be used to set state and national baselines for any carbon compliance effort including forests as a carbon offset.
3. Expand forest fuels treatment on public lands using “sustainable harvesting” practices and utilize extracted woody biomass to supplant carbon-based fuels—A key “no regret” climate policy on federal lands is to support expanded fuels treatment that can reduce GHG emissions, reduce fire hazards, and improve public health. Current estimates indicate that less than 100,000 acres of USFS land are receiving fuels treatment annually, which could easily be doubled pending environmental review and, most importantly, funding under the Forest Land Use Management Plans. Estimates of biomass residue available through fuels treatment could be in the range of 500,000 to 1,300,000 tons that could be used for the production of liquid fuels, electricity, or thermal energy.
4. Support research that tracks, monitors, and models GHG emissions from catastrophic wildfire, and research that shows project-level GHG benefits from fire mitigation and adaptation efforts. The USFS has a strong research program that already has accomplished a great deal of important research about the relationship between forests and climate change. Supporting research that provides a foundation for tracking catastrophic wildfire GHG emissions and actions to reduce these fires will help the policy discussions move from arguing the science, to actually supporting projects to reduce these risks. One key component will be to finish life cycle biomass utilization analysis (this has been started, but needs further support). Completion of this research with additional efforts, will better establish the relationship of the utilization of biomass from fuel hazard reduction treatments as a feed stock source for the production of bioenergy (liquid fuels, heat, and electricity).
5. Work with states to define how biomass extracted from private and federal lands could qualify as a renewable fuel under national renewable energy programs—Currently, the Federal Energy Policy Act of 2005 excludes the use of biomass produced from federal lands. Due to the size of the federal ownership in California this excludes approximately half of the biomass that could be used to meet the state’s Renewable Portfolio Standard for increasing the amount of renewable energy. Governor Schwarzenegger has stated that 20% of renewable energy goals and 20% of renewable fuels should be produced using biomass feed stocks. It will be extremely difficult for California to meet these objectives if federal law prohibits use of biomass from federal lands. We welcome the opportunity to work with the Subcommittee on this topic.

II. Consider state actions to assess GHGs in Environmental Impact Assessments, such as in the California’s Environmental Quality Act (CEQA), to inform similar efforts for the National Environmental Quality Act (NEPA)

In California, SB 97 (as summarized above) requires the state to develop guidelines for CEQA concerning GHGs that reinforce CEQA’s traditional framework for analysis. SB 97 is one piece of a larger state approach to regulate and control the destabilization of atmospheric conditions via analysis and mitigation such as AB 32. However, unlike the holistic and retroactive approach of statutes such as AB 32, SB 97 only addresses project-specific impacts via the development and permitting proc-

esses throughout California, and only applies to projects falling within the discretion of “lead agencies”. Further, CEQA, unlike other regulatory processes, only addresses specific impacts from projects through litigation.

NEPA is the federal counterpart to CEQA, but is in no way governed or otherwise controlled by CEQA or its analytical approach. Like CEQA, when federal actors engage in activities that could impact the environment, they are required to analyze the potential impact of those activities. NEPA regulators may choose to look to the CEQA guidelines as an example of how to prepare for this analysis in NEPA documents. Since NEPA and CEQA environmental review are often done together, use of CEQA’s approach to GHGs could prevent inconsistent results analytically. Below are two specific recommendations including:

1. As currently written, draft CEQA guidelines show a number of project recommendations that could be a helpful starting point for NEPA regulators—These Guidelines include: an analysis of the potential effects of GHGs on the environment; a calculation of GHG emissions from direct and indirect sources; determination of the significance of potential impacts assessed and supported by substantial evidence; avoid duplicative and costly analysis where it is possible to tier from state or regional efforts; adopt feasible mitigation where there are significant impacts; and Statements of Overriding Consideration will be allowed. The amended Guidelines will not proscribe thresholds of significance, require a hierarchy or menu for mitigation, or mandate compliance with statewide plans for greenhouse gas mitigation.
2. Consider use of general principles now being used under CEQA Guidelines:
 - Lead agencies will maintain traditional discretion to establish thresholds and adopt mitigation measures;
 - The GHG guidelines will not assume climate change is the impact, but rather allow lead agencies to develop science that fully describes potentially significant outcomes as a result of GHG emissions;
 - Focus on tiering from regional and statewide plans for the reduction of GHGs that will assist local lead agencies in efficiently engaging in their obligations;
 - Prevent conflation with other, related statutes;
 - Consider all interested stakeholder views are considered to ensure impartiality and fairness

III. Reduce climate change risks to public lands in California

California is already experiencing climate change impacts. For example, it is scientifically documented that sea levels have increased by 7 inches in San Francisco Bay over the last century, increasing coastal erosion and pressure on levees for California’s water supply in the Sacramento-San Joaquin Delta. The state has also seen increased average temperatures, more extreme hot days, fewer cold nights, a lengthening of the growing season, shifts in the water cycle with less winter precipitation falling as snow, and both snowmelt and rainwater running off sooner in the year.¹ The greatest link with federal lands, besides water, is the risk facing California forests and public lands as warmer and drier conditions lead to longer and more intense wildfires. In the next three decades the trend of these characteristically intense wildfires are projected to significantly increase.

EO S-13-08 provides direction for California’s state agencies to develop multi-sector, multi-agency climate adaptation strategies by June 2009 based on climate change science funded by the California Energy Commission. Seven separate working groups were established (forestry, public health, infrastructure, oceans, agriculture, water, biodiversity and habitat) and have been coordinating adaptation strategies to reduce our risk to climate impacts.

Early state implementation efforts have shown several key areas where federal lands and federal management agency assistance will be instrumental to reducing California’s climate risks. These include:

1. Establish a federal climate policy adaptation team made up of all federal agencies to translate known science into actionable climate adaptation strategies—For climate adaptation strategies on public lands to be implemented, they will require policy changes that go beyond any single agency. A working policy team should coordinate and develop strategies based on collective science in cooperation with states. California’s existing climate adaptation coordinating

¹ Moser, Susanne C., Guido Franco, Sarah Pitiglio, Wendy Chou, and Dan Cayan (2008). *The Future is Now: An Update on Climate Change Science, Impacts, and Response Options for California*, California Climate Change Center and California Energy Commission, PIER Energy-Related Environmental Research Program, Sacramento, CA, report in review.

structure and policy guidance would and should fit directly with federal agency needs.

2. Support the National Oceanic Administrative Agency's (NOAA) concept to develop a National Climate Service to coordinate climate research, and provide support to states to develop climate vulnerability studies—Climate change science and adaptive responses to climate change are being developed in every other state separately at all levels of tribal, public, and private sector organizations. Most of this work should be coordinated within one central federal entity. These diverse decision-makers require better access to relevant and usable scientific information, and assistance in how to use it appropriately and effectively. Thus, it is not enough to just do more research; what is required is improved linkage and collaboration between the sciences and the decision-makers who can use scientific findings. The proposed NCS by NOAA could and should be this vehicle, but a final NCS should be developed in partnership with the states and provide support to their state climate adaptation strategy efforts.
3. Fund more climate change research, especially related to economic impacts, to improve regional and state-level information on climate change and resulting impacts, and toward assessing climate mitigation and adaptation project effectiveness—One of the most critical challenges that agencies and stakeholders face in managing climate change risks is the lack of scientific understanding. In some instances, it is a matter of gathering and making available the data and information that have already been collected. In other instances, it is a lack of continuous data that would be needed to detect change and determine environmental trends and causes. Identifying the costs and benefits of implementing specific adaptation strategies as well as of more general, over-arching strategies, such as a research program dedicated to adaptation, is a common need across sectors.
4. Establish a system of Sustainable Habitat Reserves across federal lands in partnership with state and local partners—To protect fish and wildlife across California from increasing threats to their habitat, the federal government should work toward establishing a set of habitat reserves for vulnerable species.

IV. Ensure BLM and USFS have the financing, policies, and authority to quickly and effectively process renewable energy applications.

EO S-14-08 advances California's renewable energy goal of serving 33% of our demand by renewable energy resources. In particular, the EO directs state agencies to create comprehensive plans to prioritize regional renewable projects across all California lands based on an area's renewable resource potential and the level of protection for plant and animal habitat.

To implement and track the progress of the EO, the California Energy Commission (CEC) and the Department of Fish and Game (DFG) signed a Memorandum of Understanding formalizing a Renewable Energy Action Team (REAT). The REAT has started the Desert Renewable Energy Conservation Plan in the Mojave and Colorado Desert regions and identify other preferred areas that will benefit from a streamlined permitting and environmental review process. This will dramatically reduce the time and uncertainty normally associated with building new renewable projects.

1. Support the California REAT process to ensure BLM and FWS are able to support state and federal renewable energy goals
2. Ensure full support for recently created BLM Renewable Energy Coordination offices that will expedite the permitting of wind, solar, biomass, and geothermal projects, along with needed electrical transmission facilities. The action was taken to achieve the Congressional goal in Section 211 of the Energy Policy Act of 2005, which calls for the development of 10,000 megawatts of non-hydropower renewable energy projects on public lands by 2015.
3. Ensure the USFS finalizes its renewable energy policy assessment in the near future and work with California to update individual forest plans to incorporate these policies when complete. The Forest Service owns and manages nearly one-quarter of all the land in California. However, unlike the BLM, USFS does not have a consistent, statewide policy with regards to the development of renewable energy. Currently, individual National Forests typically determine the treatment of renewable energy on Forest Service lands inconsistently. As one might imagine, this leads to inconsistencies between Forests, even within the same Region.

CONCLUSION

Thank you Chairman Grijalva and members of the Subcommittee for the opportunity to appear today to offer testimony about how the nation can combat climate change on public lands. California is pleased to serve as a resource to the Subcommittee for future planning efforts.

Mr. GRIJALVA. Thank you very much.

Mr. Billy Frank, Chairman, Northwest Indian Fisheries Commission. Mr. Chairman.

**STATEMENT OF BILLY FRANK, CHAIRMAN, NORTHWEST
INDIAN FISHERIES COMMISSION, OLYMPIA, WASHINGTON**

Mr. FRANK. Thank you. Thank you, Mr. Chairman, and thanks for gathering everybody here today to listen to some of our maybe bad news and, hopefully, good news.

Climate change; we have to adapt to it, we, all of us, not just the Indian tribes throughout our country, and we have adapted to so many things and changes that happened throughout our thousands of years here.

My name is Billy Frank. I am the Chairman of the Northwest Indian Fisheries Commission, and I have been coming back and forth here for the last 30 years testifying in front of the U.S. Congress, and I am happy to be back here again. I have about 50 more years to go, Mr. Chairman, so hang with me.

You know, if there is any legislation to be legislated into law, we want the tribal governments to be a part of that. We, on the Pacific Coast, where I live, in the State of Washington, and represent 24 tribes along the Pacific Coast and up and down the Columbia River and the Snake River. We sit on the U.S.-Canada International Treaty. We have our science team, our infrastructure together. We manage the Pacific salmon from Alaska clear down to Mexico and the State of California and throughout the United States here, and we are natural resources managers.

When we are talking about natural resources, we are talking about warming of the water that is affecting our fish runs. We see our forests gone. We see nothing holding the water back anymore. The forests have been cut down, clearcut, and old-growth timber gone, very important to the natural resources, the food chain of our life, the cycle of life.

As I travel throughout all of our land along the Pacific Coast and throughout the Southwest here, I have witnessed things that are happening, such as the Barrow, up with the Eskimo villages up there falling into the sea, into the Arctic Ocean, the Bering Sea. I have witnessed these things, and it is not good to witness these things, and where are these people going to go?

I just came from Hawaii on a two-day meeting, and the people are preparing, in the Pacific Rim, to start moving people from these islands. Where are they going to move them to?

These are real things that are happening in our world, in our little world, around us. We have to start addressing these things, the U.S. Government and our leadership throughout our country, and, hopefully, we have a new day coming right now that we can organize and start addressing some of these things.

How climate change is affecting the tribes, and what we can do about it; we can do a lot of things. We have a lot of technology right now. We have streams that are warming up, you know, from what I just indicated about the habitat. We have to think about how we can cool those streams down so when the salmon come home, and our life comes home, back to Puget Sound and along the Pacific Coast, that we can start making the water temperature maybe cooler instead of hotter.

You know, these things are very important to life that exists out there, and the food chain is in serious condition in the Pacific Ocean. We have dead zones along Florence, Oregon, clear up into Kalaloch Beach in the State of Washington. We have these all documented by the University of Oregon and the University of Washington and California. Everything that is dying is coming to shore. We have pictures of this. This is serious.

Now, I do not know whether anybody in this room knows about these things, but we know what is going on. We are there. We are managers along the Pacific Ocean, our tribes. Within Puget Sound, we have dead zones in Hood Canal. We have dead zones in South Puget Sound, where I live, you know, 50 miles south of Seattle. We have dead zones up into the Georgia Straits into Canada. All of these things are not good things to hear.

Now, what can we do about it?

We can uphold the Interior and Commerce Departments' commitments to abide by the terms of Secretarial Order 3206; what we negotiated with the Secretary, and it took us three years to do that, the Indian tribes.

Implement salmon recovery plans and other natural resource restoration plans while supporting and harmonizing the exercise the tribal rights, the 1855 treaties.

Develop and coordinate with tribes on national energy policies to address climate change that is compatible with treaty rights and fish habitat [e.g., reduce peak demands through conservation and offset climate change pressure on salmon].

Involve tribes in climate change solutions in Indian Country, including carbon offsets, habitat protection, and energy conservation.

Reach out to the tribes as governmental partners to address climate change.

We are collaborators. We collaborate with the State of California, the State of Alaska, and the States of Washington, Oregon, and Idaho. Throughout all of the nation, we are collaborators. We try to keep the wheels on the wagon in managing our natural resources, and we all have to do that together. Thank you.

[The prepared statement of Mr. Frank follows:]

**Statement of Billy Frank, Jr., Chairman,
Northwest Indian Fisheries Commission**

Chairman Grijalva and honorable members of the Subcommittee, I am Billy Frank, Jr., Chairman of the Northwest Indian Fisheries Commission. It has been my pleasure to testify in front of the committees of the United States Congress for more than thirty years on behalf of the twenty Treaty Indian Tribes in Western Washington. Today I will share my thoughts with you pertaining to tribes and climate change—the impacts we are witnessing and the things we tribes propose be done about it.

I have been fortunate to be able to travel extensively across this continent and spend time with my Indian brothers and sisters of many tribes. I can personally at-

test to the fact that the impacts of climate change are, in fact, hurting both people and resources in the continent's interior and from coast to coast. When Hurricane Katrina ripped through the south in 2005, much attention was devoted to the unfortunate victims in New Orleans. But no one heard of the Chalmette Tribe that was completely washed away. Everything they had was destroyed, after having lived near what is now New Orleans for thousands of years. In Alaska, more than 125 Alaskan Native organizations have signed a resolution urging stronger action from Congress, as they rightfully blame climate change for endangering their lives and culture as even the mighty polar bear finds it harder and harder to survive, and peoples' houses fall into the sea, giving way to melting ice. On the East Coast, storms rage more severe due in some measure to dynamic changes in the Gulf Stream, and our own Pacific Ocean temperatures and de-oxygenated currents have resulted in killer storms and massive fish kills. All of these impacts, and much more, are brought about or enhanced by climate change, and as you know the vast majority of scientists today attest to the fact that man's pollution and exploitation are the primary cause of this phenomenon. As an indigenous person, whose parents told him the stories and taught him the things their parents taught them, I bring to you today the memories of a thousand generations, accumulated from this continent. As such I can tell you that there has been climate change before. But there has never been climate change like we are seeing today, and certainly not the kind of impact brought on so widely through the infestation of man.

As a representative of tribal leaders, I speak to you today on behalf of our people and our culture. I also speak to you on behalf of our jurisdiction. Let there be no mistake. This is a jurisdiction-related issue. Tribes are sovereign governments, and have been for a long, long time. They provide services to their citizens and watch out for their interests, as best they can, a task made much more difficult by the broken promises of our federal trustee. Tribes are also sovereign nations, and in that capacity, many of them signed treaties with the United States as they were asked to relinquish millions of acres of land for settlement. Treaties are, by definition, contracts between sovereign nations. They are also, as defined in the United States Constitution, the Supreme Law of the Land. When our leaders of seven generations ago signed treaties with officials of your government, they reserved certain rights and resources, on and off reservation, which have nonetheless been consistently trampled upon—a fact made all the more unbearable by the blind eye that past federal officials have turned to our plight.

The fact is that the tribes are typically hit first and hardest by the impacts of climate change. One of the primary reasons this is true is that our cultural resources, our foods, our water, our medicines—everything that makes us who we are—is hit first and hardest. We live on the oceans and on the rivers. We work hard to protect our people and our resources, but we still too often find ourselves ignored by our trustee, and we find that the states and counties allow people to move in on our lands overharvest our cultural resources—from berries to mushrooms—that make us who we are, even as the waters warm and the forests turn brown from intensifying heat and resulting insect infestations and rot. We see lights from houses built high on our hillsides now, and fear the impacts of the poisons that fill our rivers and seas.

Most of the studies and debates on potential climate change, along with its ecological and economic impacts, have focused on the ongoing buildup of industrial greenhouse gases in the atmosphere and a gradual increase in global temperatures. This line of thinking fails to consider another potentially disruptive climate scenario. It ignores recent and rapidly advancing evidence that Earth's climate repeatedly has shifted abruptly and dramatically in the past, and is capable of doing so in the future—to a degree that we, nor our ancestors, have ever experienced before—largely due to man's impact.

Our traditional knowledge and science demonstrates that Earth's climate can shift gears faster than anyone ever thought possible, establishing new and different patterns that can persist for decades and even centuries. Strange as it may seem, even as the Earth continues to warm gradually, large regions may experience disruptive shift into colder climates. Our ancestral memory, is backed by archaeological science. It fools some people to see more snow in some areas, but the fact is that this trend may well continue, and even bring us closer to another ice age. There are those who still foolishly say it is arrogant for man to think his activities can impact the weather. Yet, I say the real fool is one who thinks he can predict, with full accuracy, what will occur when mankind messes—as he already has—with Mother Nature.

Sadly, we have passed the tipping point with climate change. Thousands of scientists here in the United States and all over the world agree this is true. The United States has been shamefully slow to respond to this massive problem, and

has, in fact, continued to be the world's greatest consumer and polluter—choosing for years to pretend the problem doesn't exist, and in some cases even denying it. There will be many changes due to man's transgressions and disrespect for Mother Earth. There will be sea level rise and there will be some species we cannot save. There will be changes in our forests and there have already been many changes in our waters. The fact is that we must take firm action now, and listen no longer to those who would deny, very foolishly, that climate change, does not exist. It does, and we are in it.

Anticipated Impacts on The Northwest

Global warming modeling published by the University of Washington's Climate Impacts Group in two reports commissioned by King County and the Puget Sound Action Team found that the Pacific Northwest warmed up faster (2.3 degrees) than elsewhere on the planet (1.1 degrees Fahrenheit) during the 20th century.

By 2050, average annual temperatures for the Pacific Northwest could be up to 5 degrees higher than they were during the last 30 years of the 20th century. What will this likely mean to us in the Northwest?

1. Wetter winters with more intense rainfall. Drier summers. Earlier spring snowmelt. More frequent and more intense storms.
2. Significant retraction of the snowline in our mountains due to warmer winters—reducing our water “warehouse.”
3. Rise in sea level by as much as 3.3 feet in the South Sound and 1 foot at Neah Bay by 2100
4. Increased acidification of ocean water will slow or impair growth of shellfish and other species, and some species may not survive.
5. Earlier onset of spring (already 2 weeks early in parts of the Puget Sound region).
6. Inundation and shift of habitat types in existing salt marshes, mud flats, and beaches.
7. Change in salinity, stratification, nutrient cycling and ocean productivity affecting the Puget Sound food web and expanding the existing dead zones.
8. Lack of summer creek/river flows to maintain salmon runs in some watersheds, severe reductions in others.
9. Disruption to species when spring conditions trigger earlier hatching and migration or warm winter temperatures cease to trigger hibernation.
10. Increases in pests and diseases that affect crops, shellfish and forests throughout the region.
11. Intensified storm water problems: far more massive and regular flooding, erosion, and combined sewer overflows.
12. Favorable conditions for even more invasive species.
13. Negative economic effects on fisheries, hunting and gathering as well as agriculture, forestry, tourism, and even hydropower.

Our new President speaks very affirmatively, as do Members of Congress, about the fact that climate change is a reality. The fact that your members have brought “non-believers” in climate change before you to effectively and courageously accuse them of lying for profit speaks for itself. We applaud that, and we plead with you to take strong and collaborative action now. There is no time to waste. We are now in a position of adapting to pending change and trying to minimize effects. These are efforts that the Federal and Tribal, as well as State governments must work on together—cooperatively—at every opportunity.

Intertwined with climate change and every bit as severe is ocean acidification. Our oceans are poisoned. Man has put too many poisons into the air for far too long, creating challenges with acid rain which we have known about and done little about, for decades. The problem is not just atmospheric; it has reached into both surface waters and ground waters and the pollutant-problems have multiplied many times over. We have come to realize that no place on Earth is safe from this challenge. Even Alpine Lakes—places as high as one could possibly hike—are as polluted as every other part of the Earth. The same carbon dioxide that is creating the warming effect in our atmosphere is dissolving in our oceans, creating a dangerous increase in the PH of our oceans. Together, we must work to remedy this situation. There is nowhere else to go!

So, What Can We Do Together?

First, I want to re-emphasize that tribes have not been sitting on their hands. Our scientists and other workers are actively working, stretching every possible dollar, in watersheds throughout our region, to restore habitat, from stream banks to wetlands, and we work hard to convince our state and local governments that it makes no sense to keep on with business as usual, placing natural resource management

on the back burner. Even in tough financial times, if we do that, what makes sense to place on the front burner? Education? What sense does it make for us to educate our children in the classroom if we simultaneously trash the planet that sustains them? Jobs? There ARE no jobs without natural resources and the environment. Natural resource management must be placed on the front burner where it belongs. Period.

In the Northwest, there are important instances in which this has led to highly positive results, ranging from the U.S.-Canada Salmon Treaty to the Timber-Fish-Wildlife/Forests and Fish program. But, frankly, because we live in a “growth” region, much of the urban sprawl has continued and it has been a huge challenge to catch up with the impacts of growing exploitation and development. Part of the lesson man must learn from history is that it is suicidal to overpopulate, over-develop and over-exploit. The impacts of all environmental problems are inter-related, and sustainability is key to all environmental challenges, including climate change.

We have participated, government-to-government, with such processes as the Puget Sound Initiative, and more to the point with climate change, the Governor’s Climate Change Initiative. This initiative, launched by Governor Gregoire in 2007, convened a task force and a number of subcommittees. Two related legislative bills, and climate change-related bills currently being considered by the State Legislature, are just starting points. Along with other participants, we realize that a resilient system would be more able to handle change. We must create robust habitat areas, such as wide stream riparian zones and multilayered intertidal shoreline and up-land areas. For example, if increasing water temperatures or a drop in water volume will stress a stream, a thick canopy of tree cover can help minimize the impact.

We also know it is important to make hard decisions that are fair but effective. We recognize the need to focus resources in areas that will give longer-term benefits. For example, modeling shows that rainfall-dependent (i.e., lower lying) watersheds will be less affected by global warming than snow-fed watersheds. Such conditions should be considered as we plan for restoration and protection work. The need for water reclamation is very apparent. Reclaimed water is water that has already been used for one purpose, has been treated and can be reused for certain types of use (irrigation, for example). Due to state mismanagement, our rivers are over-allocated, and we must build the infrastructure now for distribution of reclaimed water—it isn’t cheap. We will not be able to afford to use potable water for non-potable needs in the future. It is critically important to leave water in creeks and rivers to support fish wildlife. It is a treaty-protected right.

We have a major problem with storm water in the Northwest. We need to reduce the need for storm water combined systems by separating sanitary waste from storm water. New capitol improvements must consider the effects of long term climate change to ensure that salmon and other natural resources critical to tribes will have enough water. Toxic chemicals and nutrients in urban runoff must be curbed. Standards must be adopted to greatly reduce impervious surfaces and infiltrate all storm water on-site, rather than conveying it to streams.

Septic systems have got to be cleaned up or replaced with clean and efficient sewer systems. It is urgent that we eliminate septic system problems because their contributions to dead zones, such as those in Hood Canal, will be amplified by climate change.

It is important to support the efforts of tribes with forest lands to consider setting Cap and Trade programs, which can be effective tools for reducing pollution and protecting human health and the environment. These systems provide efficient incentives for early pollution reduction and innovations in control technologies and work well inter-governmentally, providing multiple benefits, including greenhouse gas emission control.

Today, most regulatory actions taken by local, state and federal agencies—those which ARE enforced—are taken without consideration of potential climate change impacts. For example, new coastal structures should be designed for a higher sea level or buildings must be set back so that structural controls are not needed at all. We must be vigilant that regulations and ordinances are completely thought out. Wherever possible, the choice must be made to keep open spaces rather than build, to go with permeable rather than impermeable surfaces, and to end forestland conversion. Society needs to go on a Low-Carbon Diet. From driving vehicles fewer miles and carpooling/using mass transit to planting more trees and weatherizing houses and apartments, every citizen can and must be educated to help reduce the output of greenhouse gases.

People have got to be made more aware of Environmental Justice. The most needy in our society may be forced to pay more of their budgets for basic needs such as drinking water, energy and food because of climate change. Also, as has been pointed out, tribes live close to the water. It’s our culture, and we depend very directly

on the fish and wildlife that depend on a healthy ecosystem. We stand to lose the most from the impacts of climate change.

For many people, the issue of climate change feels like a distant idea, not an imminent threat. They're wrong, and they need to know it. We must all understand that action is needed—now. Education is, of course, one of the great things we can do—together. Tribes have too often been a voice in the wilderness on natural resource issues. We have warned, almost always without being heard, that Mother Earth must be respected, that she is fragile and delicate—that we must never take more than we need as humans, and always use all that we take. We have warned, for a very long time, that we must always think of the needs of our descendants to come—for seven generations and more, and be aware that every action we take today affects those descendants in either a good or a bad way. These principles, known by many today as sustainability, are as valuable as they ever have been. Had they been heeded when we began to warn non-tribal people about them, we would not have the climate change challenges we face today. These lessons, which have been passed to us by our ancestors, must become part of all of our legacies. As I have pointed out, we know we have passed the tipping point with climate change. There are motions in action upon our Mother Earth which we cannot stop. But we can adapt, and we can do things to minimize their impact. The lessons of our ancestors are lessons of respect, human dignity and brotherhood. They are lessons of hope.

The State of Washington passed legislation three years ago, HB 1495, as well as subsequent legislation, which made it easier for tribes and Indian teachers to convey these lessons of Traditional Knowledge, from our culture of stewardship to our languages, in classrooms across the state. Although many more of our people now complete high school and achieve higher education degrees than before, we ask you to consider increasing your commitment to Indian education. We ask you to consider legislation that would achieve similar tasks as HB 1495 on a national scale. We also ask that Congress take a stand to, once and for all, acknowledge that tribes, and the stewardship ethic we hold dear, has much to offer all citizens across this great nation, particularly in this time of dire environmental challenge. Let it be a message of truth—that in building this nation, much has been taken from the tribes unfairly, and that the human rights of the Indian people, including their treaty-protected rights, have never been understood or enforced—and that the time has come for the Native People of this land to receive their due acknowledgement, rights and respect. Let this statement from Congress also be one to educate your citizens about the great value of considering our long held values as values that have much to teach citizens from all walks of life who now call themselves Americans.

Change and/or enforce the Rule of Law. In some cases, you will need to develop new laws. In some cases, you will need to enforce existing laws. But you must work with us to identify those things that are harmful to our people and our culture—and to stop/control them. As it is, and as it has been from the beginning of our contact with one another, your people are harming these precious things. It is a direct violation of our treaties and of your trust responsibility to us. When it comes to climate change, it must begin with an assessment. Our scientists work in our watersheds and on our marine waters day in and day out, year in and year out. This assessment must be done in collaboration with us. It is a little known fact that the Tulalip Tribes have achieved the first ever full-river climate change assessment—anywhere. In a nutshell, it was found that the removal of the forest canopy and wetlands had weakened the abilities of the system to withstand floods and other impacts that will be greatly increased by the sea level rise and increased storms resulting from climate change. Effective actions obviously begin with knowledge, and that tribe is working to remedy that situation with new ideas as well as traditional ones—and, like other tribes facing similar problems, will continue to need your help to do so.

There is need for a comprehensive collaborative natural resources/environmental management plan—not just in our Pacific Northwest, but nationwide—that incorporates tribes across the country and the Federal as well as other governments. There is need for legislation calling for such a plan, and for adequate funding to back it up, and there is need for such a plan NOW. We wish to work with you to develop this legislation, as decision-makers.

We have a new Administration and I think there is no surprise in the fact that this is something our Indian Nations have prayed for and are thankful for. Our budgets have been cut back, and we have been virtually ignored for far too long. But there is new hope on the horizon. The President's selection of Carol Browner, former Director of the Environmental Protection Agency, as his Climate Change Director, certainly helps substantiate that hope. When she was EPA Director, she selected one of our tribal leaders from the Pacific Northwest, Terry Williams from the

Tulalip Tribes, to head her new Office of Indian Affairs. It was the first time in the history of the United States that such an office had been formed by the EPA, and Terry did a splendid job. We look forward to more of the same.

I must be honest. We are still waiting to see some desperately needed financial support for natural resource management requests. Those must be honored because they are needs that directly affect our treaty-protected rights and they are most assuredly inter-related with resources impacted by climate change. We will be watching that closely, of course.

But today I will simply remind you that we face a huge challenge with climate change, and that it is a challenge we must all face—together.

Realizing this, the tribes served by the Northwest Indian Fisheries Commission and those served by the Columbia River Inter-Tribal Fish Commission conducted high level meetings and strategy sessions leading up to the inauguration of President Obama, and, together, published a booklet that we make available to you today. "Treaty Tribal Natural Resources Management in the Pacific Northwest includes the specific requests being made, collectively, by the 24 treaty fishing tribes of the Pacific Northwest. These requests focus on the needs of salmon and other natural resources, and on the Federal trust responsibilities to the tribes. We ask you to note that among these priority needs and requests is the following statement on climate change:

"Climate change is real and its effects are already being felt in the rivers and streams of the Pacific Northwest. Tribes are leaders in the region in restoring riparian habitat, which is a key measure to address climate change effects. Natural resource management, climate change and energy independence are closely linked as the Northwest endeavors to safeguard salmon and other species."

We ask you to further note that we made five priority requests of the Obama Administration and the 111th Congress to fulfill its trust responsibilities as they relate to climate change. We ask you to support these priority requests:

1. Uphold the Interior and Commerce Departments' commitments to abide by the terms of Secretarial Order 3206: American Indian Tribal Rights, Federal Trust Responsibilities, and the Endangered Species Act.
2. Implement salmon recovery plans and other natural resource restoration plans while supporting and harmonizing the exercise of tribal treaty rights.
3. Develop and coordinate with tribes on a national energy policy to address climate change that is compatible with treaty rights and fish habitat (e.g., reduce peak demands through conservation and offset climate change pressures on salmon).
4. Involve tribes in climate change solutions in Indian Country, including carbon offsets, habitat protection, and energy conservation.
5. Reach out to tribes as governmental partners to address climate change.

I thank you for inviting me to testify today, and I ask that you continue to consider tribal input on climate change as well as all natural resource and environmental issues on an ongoing basis, on a government-to-government basis.

Our strength in facing the many challenges that exist today will be greater with greater understanding of treaty-protected rights, the Federal Trust responsibility to the tribes and the responsibilities we all share to the generations to come.

Thank you.

Mr. GRIJALVA. Thank you very much, Mr. Chairman.

Before we begin with questions or comments from my colleagues, let me indicate that I anticipate that we will be called to a 3:30 vote, somewhere around that time, so we will recess and return after those votes are done.

Let me ask Chief Kimbell a couple of questions. We are going to hear from witnesses later about the importance of old-growth forests in combating climate change, based on the amount of carbon stored in mature, old forests. Has the Forest Service conducted any studies on this particular subject, this matter?

Ms. KIMBELL. Yes. The Forest Service has conducted studies on the amount of carbon sequestered in different kinds of forests and the rate of carbon sequestration. So much depends on the health and vigor of those forest stands, where those forests are located, and their risk or susceptibility to catastrophic wildfire.

Mr. GRIJALVA. Thank you. Under current law, the National Forest Management Act and NEPA, are those sufficient to deal with the impacts, the mitigation, and the adaptation that might be required by agencies, such as the Forest Service, in the future? I guess the question is, do we need updates on those laws to deal with this?

Ms. KIMBELL. When NEPA was passed in 1969 and the National Forest Management Act in 1976, I do not think anybody could have foreseen the kinds of change and the rate of change that we are going through right now, and, no, the language that is in those two acts does not begin to address the rates of change that we see in the ecosystems that we work in.

In January, the Forest Service issued direction to all of our field units to incorporate discussion of climate change in all of our environmental analyses and in the national forest planning process. Along with that, we have a group of scientists working together, not just Forest Service scientists but working with others, and looking at the global information available on climate change and working to try and scale that down to different scales so that it can be, at least, referred to in an environmental analysis.

It is so very hard to predict what might happen in one single location, given the kind of global information that we have right now that has been through a peer-review process and science.

So we do have a team of people that is working together to try and help us scale down that information to make it more usable at the local level, and we hope to have something very soon. But we did issue direction in January, and we think we can work within the regulatory framework to continue updating that information.

Mr. GRIJALVA. But there needs to be, at some point, a revision update of the particular laws that I referenced.

Ms. KIMBELL. It could be in statute, but it might very well be in the regulation.

Mr. GRIJALVA. OK. Thank you.

Mr. Armstrong, in the last administration, adequate protection of our natural and cultural resources was on the back burner as we moved forward on expedited energy permitting. Moving forward now, how will you see adequately protecting the integrity of natural and cultural resources on these public lands in reference to the whole discussion we are having today about climate change and the need to protect and conserve those areas?

Mr. ARMSTRONG. Mr. Chairman, I think that everybody at DOI would agree with your statement that we need to take a balanced approach when we look at climate change and its impacts, the relationship to energy resources and natural and cultural resources as well.

At the Department of the Interior, including USGS, who I work for, the science wing of the Department of the Interior, we are constantly striving to better understand that balance and to achieve that balance, and I know that that issue is of paramount importance to Secretary Salazar. But early in the start of his tenure, I am sure he will be giving great thought to that and bringing his forming team together to address that issue more effectively.

Mr. GRIJALVA. Thank you. You are very kind.

One other point: Presently, Mr. Armstrong, does the Bureau of Land Management currently have the capacity to monitor the impacts of climate change on the vast resources that they are responsible for managing?

Mr. ARMSTRONG. I think that the Bureau, from my personal experience as the scientist in charge of the U.S. Geological Survey and my interactions with scientists and managers at the Bureau of Land Management, they do a very good job, a very effective job, of managing their natural resources through monitoring programs.

But I will say this, that the Department of the Interior, across all of the career employees I have ever talked to, we realize that no single bureau can do it alone. It takes not just the entire Department working in unison to coordinate and communicate its vast fleet of monitoring assets, but we need to work with other Federal agencies, such as NASA, NOAA, the U.S. Forest Service, which we work very closely with, to provide additional information on monitoring on and off the Bureau of Land Management's jurisdiction.

In order to really understand climate change, we need to get beyond just the immediate jurisdiction of the Bureau of Land Management, the Fish and Wildlife Service, the National Park Service and look at the system in totality, and, in order to do that, we all need to be working together with state and local agencies, with tribal organizations, with academia. It really is that large of a problem. We all need to be working together.

Mr. GRIJALVA. That leads me to the question for Mr. Brunello. In your testimony, you recommend the formation of a Federal Climate Change Adaptation Team. We just heard Mr. Armstrong speak somewhat to that. How important is that coordinated Federal effort, over different boundaries of our land management agencies, to deal with this subject area?

Mr. Brunello. I am glad you asked that one. It is dear to my heart.

I think, right now, in California, as an example, we are developing our statewide adaptation strategy. What is helpful for all of us, as you move ahead in any new effort, is you stay in your stovepipe, and so here, in the natural resources agency, we have energy, water, Fish and Game, and other committees that are in our jurisdiction, many areas that will have environmental impacts.

What we have learned is we cannot really develop thoughtful, thorough adaptation strategies unless we communicate with our public health officials, for example, or our air regulators, or our Department of Transportation. It does not work.

So what really needs to happen is to step even outside of the land management agencies. For example, the transportation issues you will discuss in this coming year; that is huge. That area, for us in California, is what guides a lot of our habitat restoration efforts.

So what we are trying to accomplish is challenging. It is not easy, by any means, but what has to happen is to have the Federal entities have some type of framework that are the policy people having discussions that are using information that is fed up to them on adaptation measures so they can talk and discuss and

work things out. It is not going to work if it is just the science, and that is what we are learning.

To do an adaptation strategy requires three things. First, you need good science, so you need to support the science; but, second, you need to have strategies that actually allow you to adapt to future climate impacts; and then the third part, which we have all missed the boat, is actually to act, and we want to get beyond research and to actually fund action.

I know that is tough in all of our budget climates, specifically, in California, but, really, you have to move to actually fund things. That does not mean all new resources. It may mean just including things in new roads or in development of new properties along the coast that are going to experience sea level rise.

So I think having it outside of just the land management agencies is fundamental in where you move forward.

Mr. GRIJALVA. Thank you.

Last question: Chairman Frank, what would be the immediate steps that the Federal government could take to improve the involvement of tribes, Indian Country, in the climate change adaptation efforts, policy efforts?

Mr. FRANK. One of the things I see is that we are not included a lot of times within the state and then a lot of times within the Federal government. It seems to me, like, when the states and the Federal government include the tribes, they have success, but when they do not include the tribes, they do not have success.

I see too many people micromanaging our resource, micromanaging it from the outside, and they are old, retired people that are going around, and they want to make money now; they are consultants, you know. We have to stop.

Mr. GRIJALVA. Like some Members of Congress.

Mr. FRANK. Yes. I mean, it has got to stop. We have to start managing. We cannot be walking around, saying, "Hey, we are going to study this one more time." We are studying it.

This is real. This climate change is real, and it is upon us, and the temperatures are warming up, the floods are coming, and the storms are here, and we have to adapt to that, but we have to put it together. We have to manage together.

Mr. GRIJALVA. Thank you, Mr. Chairman. Mr. Hastings?

Mr. HASTINGS. Thank you, Mr. Chairman. Chief Kimbell, in your written testimony, you made reference to managing forests and, specifically, thinning forests. You did not say that orally. If you did, I apologize; I did not hear it. Would you elaborate briefly on that?

Ms. KIMBELL. I would be happy to. Thank you.

The reference to thinning forests; I think we have some fabulous examples just from the last several fire seasons. One I will point to, since there are so many folks here who are familiar with California, is the Angora fire near South Lake Tahoe, where, through extended public involvement and work in a collaborative process, there was a whole series of hazardous-fuel-reduction projects identified, including thinning.

When the Angora fire was started by a campfire, it burned very quickly through a whole drainage and burned quite a number of homes. The fire behavior was monitored in both the areas that had been thinned and the areas that had not been thinned. The fire

mortality was measured in the areas that had been thinned and in the areas that had not been thinned, and there were significant differences in the intensity of the fire, the fire behavior, and the mortality of the remaining trees in those areas.

I think that that is just one example. We have many others around the West, and we have quite a few in the East now. We have a fabulous example in Florida, where the fire that was burning in the Okefenokee Swamp two years ago, when it came out into the Florida forest lands, the way it burned through areas that had not been treated was very, very different from the areas that had been thinned, and where the areas had been thinned, actually, fire-fighters were able to suppress that fire.

Mr. HASTINGS. Well, I want to congratulate you. I have always felt that that is an integral part of managing our forest lands.

Today, we got a news release from Sierra Pacific Industries, in Redding, California, saying that they are closing one-half of their two-mill complex, and it is the small log complex. The significance, I think, of Sierra Pacific is because this is part of the Quincy Library Group negotiations that everybody up and down the West Coast, and probably nationwide, was aware of because it was a very difficult agreement that was put together. But everybody felt that it was going to work, and, as a result of that, Sierra Pacific built this small log facility.

They are now closing it because, as they say, in their news release, there is not a sufficient amount of small logs coming off national forest lands to keep this mill going. In fact, they cite that the target of the Quincy Library Group was whatever it was, but they have only been able to log about 20 percent of the target because of litigation. Do you have a comment on that?

Ms. KIMBELL. Well, I would add to litigation the incidence of wildfire.

I visited on some of those forests last summer after the great, big fire siege that started in late June, with all of the lightning that hit across Northern California, and there were a number of those projects that the Quincy Library Group had worked so hard on for so long that had come through the appeals process and litigation, and those projects were ready to be implemented when the fires burned through those projects and changed the condition rather dramatically.

Mr. HASTINGS. I mean, it begs the larger question, it seems to me, if we are going to look at climate change and how to somewhat mitigate what would happen with natural forces, like forest fires, for example, and I heard that the forest fire in Australia put in the air more than double what Australia civilization puts in the air in one year, that national forest. But it disturbs me to see that a mill is closing down because they cannot get small logs. Small logs are essentially what you thin, and they can only get 20 percent of the target.

So that leads, I guess, to a larger question that I would like to ask all of you. If litigation is somewhat of a problem that affects climate change, is there a place for looking at the regulations that guide us on this that should be looked at and perhaps changed?

I would ask this of Interior and BLM, specifically, because you have more open lands where, presumably, alternative energy

sources, like wind and solar, would be in place. Would you be in favor of reducing some of the regulatory measures so you would not have the litigation to cite these potential projects?

Ms. KIMBELL. I think Mr. Brunello answered this question in his oral comments, to some extent, the need for adaptive management.

Mr. HASTINGS. Well, I know my time has run out here, but go ahead and respond, and I will make a statement, and maybe you can respond to that one.

Mr. ARMSTRONG. The fundamental thing in California, which we are continually addressing, is the fires are not going to stop, and that is a fundamental issue, in our mind, is that we see the fires getting worse, they are year-round, and they are going to continue to happen.

So as you discuss about how can you feasibly and economically use the dead and dying wood there, we can keep wrestling about the science and keep wrestling with options, which I think we have to do, but we keep seeing the fires. So we are looking for all different—

Mr. HASTINGS. Well, maybe a short response to that is to use that biomass in some way to create electricity. It seems to me to be an obvious thing to look at. If you are going to have these fires all of the time, and it is predictable where it is, why do you not go in and thin it and use that biomass? That might be one thing you ought to look at.

I have to say this because, last week—California is supposedly the forerunner of alternative energy sources, and I found out, for goodness sakes, that they are going to buy wind energy from my district—apparently, Con Edison, or whoever it is down there in Southern California could not build enough wind energy to satisfy your constitutional needs, or, at least, statutory needs, of so much alternative wind, so now you are going to buy it from my state.

I find that just absolutely incredible. I guess we do not mind the business, but, for goodness sakes, if you are going to have all of these regulations, then why do you not become sufficient?

The wind always blows on the ocean. It seems to me that that would be a pretty good place to put wind farms. Has that ever been talked about?

Mrs. CAPPS. It sure has.

Mr. HASTINGS. It has?

Mrs. CAPPS. Oh, yes.

Mr. HASTINGS. And what has been the response?

Mr. BRUNELLO. In my testimony as well, one of the things that we are pushing right now is to try and have our utilities, and all utilities across the state, have 33 percent of their electricity drawn from renewables. So we are doing a number of efforts, and the state Governor, Schwarzenegger, just announced that they did a complete reorganization of all of our energy agencies so we can align our transmission-corridor-permitting authority.

We are also looking at, with BLM, Fish and Wildlife Service, how we can improve our land-permitting system so that we can have large, consolidated—we call them “NCCPs”—Natural Community Conservation Plans so that you are not having different little blotches all over the state for wind or solar or geothermal but try and consolidate in areas that have a low impact.

So we are focusing very much with our Federal partners.

Mr. HASTINGS. Well, so far, you have focused them in central Washington. I guess I should be thankful for that.

Mr. Chairman, thank you for your indulgence. I ask unanimous consent that the press release from Sierra Pacific be part of the record.

Mr. GRIJALVA. Without objection, sir.

[The Sierra Pacific press release submitted for the record follows:]

Sierra Pacific Industries
P.O. Box 496028
Redding, CA 96049-6028
(530) 3788000

For Immediate Release
March 2, 2009

Contact: Mark Pawlicki
530-378-8000

**Sierra Pacific Industries Announces Mill Closure at Quincy, California—
Blames Environmental Litigation and Market Conditions**

Anderson, CA—Sierra Pacific Industries (SPI) today announced it will close its small-log sawmill located in Quincy, California on May 4, 2009. According to SPI, the challenging lumber market combined with litigation over timber harvests on nearby national forest lands were the primary drivers behind the decision to close the plant.

“We are deeply saddened over this announcement, as many hard-working, dedicated employees who have been with the company for a long time will be unemployed,” said area manager Matt Taborski. “The reduced availability of national forest timber resulting from litigation forced SPI to transport logs over long distances at greater cost to keep the mill running,” he added. “Today’s lumber prices are not sufficient to cover these increased costs. To make things worse, environmental litigation has not only reduced the mill’s raw material supply, but also increased the risk of wildfires in the area,” he continued.

This mill is part of a two-mill complex—one cutting small diameter logs and the other cutting large diameter logs into lumber for domestic consumption. About 150 employees will be affected by this closure. Approximately 160 will remain employed at the large-log facility and biomass electric generation plant.

The Quincy mills rely in large part on the sale of national forest timber for their raw material. Sierra Pacific constructed the small-log mill when it appeared the Berger-Feinstein Quincy Library Group Forest Recovery Act (QLG) would pass in Congress. That law approved in 1998, promoted tree thinning on national forest timberlands to reduce the threat of wildfires while providing raw material for local manufacturing. It was anticipated that the QLG Act would result in the harvest of enough small diameter trees to run the mill.

Unfortunately, environmental activists have brought a series of appeals and lawsuits against these projects, drastically reducing the amount of timber available for harvest. Overall, the Forest Service has been able to achieve less than 20% of its QLG sawlog sales target due to appeals and litigation. Nearly two-thirds of the current year’s timber sale program is enjoined or withheld from sale pending the outcome of litigation.

Workers at the Quincy mills are represented by the Carpenter’s Industrial Council. Employees and union representatives were informed of the mill closure during meetings today. Sierra Pacific spokesman Mark Pawlicki stated, “SPI will consider affected employees for other potential opportunities within the company for those who are interested in relocating or transferring.”

Sierra Pacific Industries is a third-generation family-owned forest products company based in Anderson, California. The firm owns and manages nearly 1.9 million acres of timberland in California and Washington, and is the second largest lumber producer in the U.S. Sierra Pacific is committed to managing its lands in a responsible and sustainable manner to protect the environment while providing quality wood products for consumers.

Mr. GRIJALVA. Mrs. Capps, any questions, comments?

Mrs. CAPPS. Please, and thank you, Mr. Chairman.

First, to Mr. Frank, my constituents of the Chumash Nation will be very pleased, Chairman Frank, to know of the wisdom that you have shared with us, wisdom that comes from the ages, and you spoke on their behalf as well, so I thank you for that.

I also want to thank all of the witnesses for your excellent testimony and to remind you, Chief Gail Kimbell, that we met, I believe, in Santa Barbara, when you were honored by the Forest Service Foundation a few years ago, and it is a pleasure to have you be here today.

I have a question for you, and I also cannot skip by my Californian, Mr. Brunello, for a question as well in this short time.

Of course, the warming climate is contributing to longer wildland fire seasons with more extreme events, greatly increasing the risk to human lives and buildings, particularly within the wildland-urban interface. I do not have to remind you of three major incidents in Los Padres National Forest, which are close to homes in my district, in the last year and a half, most recently, the Tea Fire last fall, just a few months ago, in which over 230 homes and part of a liberal arts college were burned to the ground; the Gap Fire, earlier that summer; and also, significantly, the Zaca Fire in the summer and fall of 2007, one of the largest fires in the history of California. Over 200,000 acres burned over a three-month period of time. We still have the ash in our neighborhoods from that particular fire.

Wildland fires are likely to become increasingly difficult to manage unless we can figure out fire-dependent ecosystems in the near future and also do some really serious, long-range planning, which you have touched upon, and I thank you for that.

As you described the way the Forest Service is collaborating among fire and climate scientists, maybe you could be specific. I am thinking particularly of the homeowners in Santa Barbara who want to rebuild those homes, and I have heard of—I will set this out for you—some adaptive-management strategies.

I heard of one called “Firewise,” and maybe you would describe it for us because it is going to make a tremendous difference. As Tony said, we are going to continue to have fires. What we have to learn to do is be smart in adapting to them.

Ms. KIMBELL. And thank you for that. “Firewise” is a wonderful program that we implement across the country, but it helps communities be able to help private landowners design their homes, design their facilities, and design their landscaping with fire in mind. So it provides information about different kinds of building materials, different kinds of landscaping, and spacing.

We share responsibility for this program with the state foresters, and we deliver it. California certainly has a very active Firewise program, as does Nevada, as do most of the states that have heavy fire programs.

There is fabulous information available there, and I encourage not only the forestry community to be interested in it but certainly communities who are setting standards and guidelines for the construction of homes, whether they are being reconstructed or brand-new construction, for the construction of homes and businesses in fire-prone areas.

Mrs. CAPPS. And, Mr. Chairman, if I could request that Chief Kimbell maybe submit a document to that for the record of this testimony, I would appreciate that.

Ms. KIMBELL. We would be happy to.

Mrs. CAPPS. Thank you. Mr. Brunello, you spoke already about projections to programs and plans enhancing our ability to manage our public lands using the science that is available, and you really touched us when you said, We have to act. We cannot just study this any longer; we have to act.

Specifically, what lessons can be learned and applied at the Federal level from California's efforts to integrate climate change into CEQA, into the California design?

Mr. BRUNELLO. That is probably for a whole hearing.

Mrs. CAPPS. I know it is. I am so sorry, but I want to get it out, at least, to start.

Mr. BRUNELLO. Exactly. We had a bill called S.B. 97 that was passed two years ago that was to provide guidance for all projects on how to account for greenhouse gas emissions. So it was probably hastily completed, many would say, and what we are learning is that there is a very narrow focus, looking specifically at projects and, more, in particular, projects that are litigated. But what we have found, particularly in the testimony, it hits on start with the basics, account for greenhouse gas emissions on projects.

There is debate about what thresholds do you use for greenhouse gases. Should it be zero? Should there be some formula?

We are finding it very difficult, but we know that people, at least, have to track their emissions and to mitigate for those emissions, so that is a primary thing you should walk away with.

How you deal with climate impacts is exceptionally challenging—that is something that I know was mentioned by the Chairman—and, in particular, what we are finding in our science is that you really need to ask three questions, and I think, on some areas, we are just not there yet. We are trying to push as much as we can, but what impacts happen where, when?

Mrs. CAPPS. Yes.

Mr. BRUNELLO. Three very basic questions, but if you are looking at specific projects, with NEPA, in particular, it is very difficult to answer those questions.

The final big question is cumulative impacts, and I would leave it with what is even more important, is that there is comprehensive climate legislation that is passed and that specific projects, as you are doing a CEQA or a NEPA analysis, and they will go together, link with that broader structure because if NEPA is done on its own without the bigger context, it creates a number of difficulties.

Mrs. CAPPS. That is a very good summary, for starters. Thank you very much.

Mr. GRIJALVA. Mr. Bishop? No? Excuse me. Mr. Coffman?

Mr. COFFMAN. Thank you, Mr. Chairman and Ranking Member Bishop, for holding this hearing today. Our public lands are a valuable resource. They provide many opportunities for outdoor recreation and hold vast energy deposits.

Trees also act as carbon repositories. As they grow, they absorb carbon. When trees die, they cease to absorb carbon and begin

slowly releasing it back into the atmosphere. This carbon can also be released rapidly during forest fires.

In Colorado and across the nation, we have vast swaths of standing dead trees waiting to erupt in flames. This will threaten lives and property. It will also release tons of carbon into the atmosphere. Each year, millions of tons of carbon are released into the atmosphere by carbon. According to the National Center for Atmospheric Research, during Colorado's 2002 fire season, just as much carbon was released into the atmosphere from forest fires as was released from the entire state's transportation emissions.

Now, we have a choice. We can push policies that will prevent catastrophic fires, or we can go with the status quo and allow hazardous fuels to continue choking our forests. I, for one, hope we will pursue proactive policies of active forest management.

Chief Kimbell, thank you for your time today. A 2007 report by the University of Colorado and the National Center for Atmospheric Research estimated that fires release about 290 million metric tons of carbon dioxide a year. It seems to me that reducing forest fires would reduce carbon emissions. What are the main obstacles in the way of doing fuel treatments in our forests and getting ahead of these fires before they start?

Ms. KIMBELL. Thank you, Mr. Coffman. Since the start of the National Fire Plan, together with Department of the Interior agencies, we have treated over 30 million acres of public lands for hazardous fuels. About 19 million of that has been on national forests and grasslands.

The Colorado situation is something we have spent considerable time talking about. We focused resources there, last year and this year, to work together with the State of Colorado to treat lands. We are working with Denver Water. We are working with a whole host of interests in that front range country and what some people like to call the "back range."

Challenges to being able to conduct those treatments are partly around just the social license to be able to conduct those treatments. There are many people who really do not want activities on their public lands and are very vocal about that, very active in that, and these are public lands. We manage them for the public. We do it in a collaborative process. We encourage public involvement, to a great extent, in everything we do. Part of it is social license and the ability, then, to be able to move projects forward in a timely way.

The Forest Service has a research project—it is actually in California—the Alder Springs project, where we are working hard on managing, analyzing, and measuring a whole carbon budget around the issue that you raised with the amount of carbon being produced in a fire versus the carbon that might be removed and put to another product while another healthy, green stand is allowed to get started and to start sequestering carbon rather than emitting carbon. But the Alder Springs project has a lot of great potential to be able to teach us a lot, and there are some similar projects around the country.

Mr. COFFMAN. Would any other panel members like to comment on that?

[No response.]

Mr. COFFMAN. Mr. Chairman, I yield back the balance of my time.

Mr. GRIJALVA. Mr. Heinrich, any questions?

Mr. HEINRICH. I do. Chief Kimbell, it is great to have you here today. Are you familiar with the Gila National Forest in New Mexico?

Ms. KIMBELL. I have read a lot about the Gila, never spent a lot of time on the Gila.

Mr. HEINRICH. I would encourage you to spend time there. It is an incredible place.

My background, for a number of years, I worked as a guide outfitter, taking kids into the back country, and managed a 540-acre forest property that had been cut around the turn of the century back in probably the 1910's. That property had incredible proliferation of small-diameter trees because of the combination of fire-suppression and previous management activities.

You know, I am somebody who has literally cut down tens of thousands of trees, and I do not apologize for that fact because we were trying to restore a forest condition, but I think this broad-brush approach that says that the only way to reduce, you know, the potential for catastrophic wildfire is sometimes simplistic.

The example I would give is that the healthiest forest I have ever seen is in the middle of the Gila wilderness, and the reason why it is so healthy is because it has never been fire suppressed. The Ponderosa pines are three-to-four-feet thick. There is very little underbrush to create ladder fuels to the surface.

So, I guess, one of my questions revolves around the fact that if we are going to do these treatments that put us back on the track within ecosystems that are fire-adapted, and anytime you are dealing with Ponderosa pine, you are dealing with a fire-adapted ecosystem, is it feasible, even, to do those treatments, other than concentrating them around the urban-wildland interface, but in the broader areas, where we want to restore a more natural condition, a condition that is better fire-adapted? If not, do we need to then rely on the judicious use of prescribed fire to create that natural condition?

Ms. KIMBELL. Well, you are absolutely right. There is no one answer. There is no cookie-cutter approach to dealing with the health of forest land. Some of our employees like to talk about how forests are really the lungs of the earth, and a healthy forest is taking in a lot of carbon and putting out a lot of oxygen.

Part of what we have learned in our climate change research is that there are very different things going on in different places in the country, and we cannot assume that what is going on in New Mexico is the same thing that is going on in Florida. That is the important part of stepping down some of this global science that we have and being able to step it down to a more local area so that we can look at the opportunities in different places to be able to improve that forest's ability to be able to sequester carbon and provide all of the services that we look to have off of those National Forest System lands.

With that, in many of our Forest Service regions, we have taken a regional approach to look at the priorities for treating lands to

prevent those catastrophic wildfires and the effects of those catastrophic wildfires.

So there are many places that are prioritizing treatments that may be far outside the wildland-urban interface, but some other areas that might need some address to be able to perhaps prevent that fire, when it does get started, from roaring into Big Sur or wherever else, into Evergreen, Colorado, and to be able to improve the health so that that forest is able to handle precipitation, so it is able to sequester carbon, so it is able to provide the recreation resources that we count on from our public lands.

So, yes, we are looking at the whole spectrum of lands and not just in the wildland-urban interface.

Mr. HEINRICH. Just a quick followup. Do you have a sense for the relative cost? What does it cost these days to go in, and I know it varies widely by forest type, but when you have to manually thin an acre of forest, what does that generally cost the public?

Ms. KIMBELL. There is no single number I can quote you. A key component is in what might be available in the local community to be able to use that woody biomass that might be cut, that might be removed, where there is an outlet for that that makes it much more economical to be able to treat those acres.

There is a symbiosis here where being able to treat those acres can also be very, very good for a community, and those things need to be considered as a whole and not in separate parts.

You mentioned prescribed burning before. Prescribed burning in Mississippi is much cheaper than prescribed burning around Lake Tahoe. There are just different costs. There are different factors of doing business in a wildland-urban interface on steep hills with continued drought and other issues versus doing it in a recurring area that might be a gentler terrain, and many other factors.

So it is really, really hard to give you a number for what it might cost for thinning because it really varies, depending on what the rest of the industry's infrastructure might look like, or what the economic opportunities are around that project.

Mr. HEINRICH. Mr. Chairman, I yield back.

Mr. GRIJALVA. Thank you. Mr. Bishop?

Mr. BISHOP. Chief Kimbell, if I could just ask one quick question. So you are recommending that we burn Mississippi. Is that what you are saying?

Ms. KIMBELL. No, absolutely not, but I do recommend that we keep underburning to be able to do the kind of work we are doing on restoring long-leaf pine.

Mr. BISHOP. Let me ask you about one area that is slightly different from that because we will have other testimony coming in later. To try and put some parameters around the magnitude of the effect of the alternative energy sources, particularly wind and solar, and how that will have on public lands, some people have estimated that tens of thousands of square miles will be needed to meet even a fraction of our power needs, if we are using wind power; the same kind of concept with solar power.

Can you put into some kind of perspective the spacing needs that would be needed for wind or solar as it supplants traditional forms of power?

I can see, by your face, you want to give me that in written form.

Ms. KIMBELL. I would love to give you that in written form, Mr. Bishop, if that would be all right with you.

Mr. BISHOP. That is fair game. Thank you.

Ms. KIMBELL. Thank you.

Mr. BISHOP. For a price.

Mr. GRIJALVA. Thank you, Mr. Bishop. Ms. Shea-Porter?

Ms. SHEA-PORTER. Thank you, Mr. Chairman. I referenced New Hampshire in the beginning of my remarks, and we have certainly had a terrible time. I do not think there are too many people in New Hampshire who do not believe we are experiencing climate change.

Our little state had a tornado that impacted 55 miles last summer. That came after several floods, and then, in December, we were visited by an ice storm, the likes of which we have not seen, that put power out for about 450,000 people. It was really very, very damaging.

In looking at all of this, and knowing that we have 16 miles of ocean—do not laugh, California—they are beautiful—and we have some stunning mountains, but what is your plan now for New Hampshire and for the Northeast? We have a variety of environmental problems, and we have people working on it. The University of New Hampshire certainly is in the forefront for this.

What is your plan? Who are you working with right now, and what is going to be the change in your agency in the way that you actually implement management for our mountains?

Ms. KIMBELL. I have family in New Hampshire and Vermont, and they have not complained about the snow this year. They have just loved the snow, but they were very unhappy about the power outages. They are all skiers.

The work we are doing in the White Mountain National Forest and in the Green Mountain National Forest is very important. We have been working together with not only those universities—the University of Vermont, my alma mater, and the University of New Hampshire—but also with landowners in Maine, New York, Massachusetts, Connecticut, and Rhode Island.

We have a research station, we have people actually physically located in New Hampshire and Vermont who are working together with all of those different entities, looking to incorporate the climate change science into our on-the-ground management so that Dr. Cleaves' staff is working with the staffs on the national forests to do a technology transfer, but also working with the state foresters to ensure that technology transfer.

We just recently published a paper where we noted the migration of a number of hardwood species that, with monitoring, we have been able to demonstrate that there are 30, I think, hardwood species that are actually moving in their range. They are moving northward. It has been the subject of anecdotal kinds of conversation for many, many years, but now we actually have the science to show that.

That is the kind of information we want our on-the-ground managers to have, whether they are working on national forests or any forest land, to be able to assess what species are going to fare well on different sites and what species might be able to provide the

most to us, in terms of sequestering carbon and providing clean water and clean air.

Ms. SHEA-PORTER. Thank you. So do I have one more minute?

So do you anticipate any changes? There is a lot of debate about land use up in that area, recreation versus economic impact there. Do you have any changes planned, or are we going to see pretty much the same policy of management that we have had over the past years?

Ms. KIMBELL. The White Mountain National Forest recently completed its land management plan. The piece that needs to be continually addressed is the adaptive management piece, which I think is a very good tie to what we have been talking about in this hearing, with adaptive management related to climate change. The science needs to continually influence the implementation of that forest management plan.

Ms. SHEA-PORTER. OK. Thank you very much. I yield back.

Mr. GRIJALVA. Thank you. Mrs. Lummis, any questions?

Mrs. LUMMIS. Yes, Mr. Chairman. Thank you.

Chief Kimbell, welcome. It is nice to see you. I am from Wyoming.

Ms. KIMBELL. The great State of Wyoming.

Mrs. LUMMIS. The Great State of Wyoming, and I want to follow up on something that my neighbor to the south, Colorado, was touching on earlier.

The beetle kill in Colorado and Wyoming is absolutely devastating. In fact, your own Forest Service predicts that, by 2012, beetles will have killed nearly all of the mature, lodgepole trees in Northern Colorado and Southern Wyoming.

I believe that my neighbor, Mr. Coffman, and I could agree to that assessment. It is a frightening prospect.

So my question for you is, what types of adaptive-management tools would allow you to better manage this devastating problem? And, furthermore, when you were speaking earlier, you mentioned treatments for hazardous fuels, and I am just curious as to what that means in lay language.

Ms. KIMBELL. That is an excellent question because we have gotten wrapped around the axle just a couple of times talking about hazardous fuels: What are "hazardous fuels"? Hazardous fuels are fuels that may contribute to irregular or dangerous fire behavior so that they might be ladder fuels, as was discussed earlier. They might be so many tons per acre of a certain moisture content. It really varies from site to site.

Lodgepole pine is an interesting species, in that we know, from the fires in 1910, the forests that came back after the 1910 fires and the lodgepole pine type came back almost 30,000 stems to the acre. I worked on a forest in the Great State of Washington where we had 30,000 stems to the acre, pretty significant.

Lodgepole pine is a species that is susceptible to insect and disease, particularly when it reaches some stress level when it is about 100 years' old. I think we are seeing that not only in Colorado and Wyoming; we are seeing it in Idaho and Montana, and, certainly, British Columbia and Alberta have been through some pretty exciting times with Banff, Jasper, and the mountain pine beetle epidemic there.

So when I talk about adaptive management relative to lodgepole pine, there are things we can do to address the density of forest stands. Certainly, the density contributes to the physical stress that they experience during periods of drought.

I also had some discussion with a silviculturist in Vail, who was talking about the appropriateness of planting different species perhaps at different elevations to be able to have some confidence that it would be a long-lived species and to be able to provide all of the benefits that we look for from trees.

So adaptive management may take a number of different roles. We are trying to address the issue in Wyoming with our Economic Recovery and Reinvestment Act funding, and we hope to be able to get on that one right away.

Mrs. LUMMIS. Thank you very much, and I hope to follow up with you specifically on that point because we are terribly concerned, so thank you very much for addressing that.

I am wondering, as a followup, whether there is a way to turn lemons into lemonade here, in that because of the massive pine beetle kills in areas, is it possible to address the biofuels issue with pine beetle-killed trees; in other words, to harvest the dead trees to create biofuels that would help expand our energy portfolio in this country and diversify it so we are turning these dead trees that are potential fire hazards and potential carbon emitters, in the event of a conflagration, into biofuel, which then actually becomes a diversifier to our energy portfolio?

Ms. KIMBELL. Absolutely, and we do have a part of our science program that is focused on looking at the opportunity to create liquid fuel and wood products from cellulose. The Forest Service is not working on that alone. Certainly, the Department of Energy has interest in that, and we have been working internationally with Sweden, Finland, looking at the potential for converting cellulose into some kind of liquid fuel, and there is tremendous potential right there in Colorado and Wyoming.

Mrs. LUMMIS. Well, I am very pleased to hear that.

Mr. Chairman, just one comment. Mr. Bishop mentioned earlier about the footprint of wind-energy turbines. One of the reasons for the spacing requirements is because of the wake effect. When the wind turbines turn, they create a wake that affects those wind turbines behind them and behind them, so spacing becomes a big issue.

So when you are doing a massive wind-energy project, which is really required in order to justify putting the transmission lines into it, it takes up enormous acres. So I do think we have to look at some other alternatives, like offshore, and improve the technology so that is possible; otherwise, we are taking what is a very small footprint, with this new directional drilling of oil and gas, where you can drill 55 wells on one wellpad and recover oil from an octopus-like structure underground, and, instead, replacing it with something that really covers thousands, tens of thousands, of acres of surface and destroys the viewshed. So thanks, Mr. Chairman, and thank you for being here.

Mr. GRIJALVA. Mrs. Napolitano?

Mrs. NAPOLITANO. Thank you, Mr. Chairman. I am very glad to see our California representative here, who has been very active

with the Bay-Delta on analyzing the sea level rise. It is quite important in my Subcommittee on Water and Power, and power being the energy.

Ms. Lummis, you brought up a great point because I toured the Western Area Power Administration (WAPA) last year. I took a helicopter tour to check out the forests because the energy grid goes right through the forest, which is a great issue in my Subcommittee. And I found out that they are trying to expand their right-of-way so that they can be able to service the lines, and they are not able to because of different things that happened between the agencies. And I would hope that they begin to talk to each other and be able to allow this to happen without having a whole gamut of policy decision because this is beneficial not only for a firebreak but also to be able to allow servicing the grid energy.

Yes, the pine beetle and the stress that is caused by the lack of water, supposedly—this is the briefing we were given when we were there—and the fact that there are, I would say, millions of trees—from my look at it, I could almost see some areas that were totally brown—that somehow we would be able to utilize it, but I am afraid, if you are going to use them for wood product, unless you treat that wood product, that you are going to have some kind of a contamination somewhere along the line.

So, effectively, maybe biofuel would be something that would be a new energy producer for the area that would create new jobs and green technology because there are ways of being able to scrub the smoke coming out. It is happening in California.

Essentially, I am concerned that maybe the agency is not necessarily collaborating. Is it because of funding? Is it because of lack of personnel? These decisions are not made to be able to allow these expansions to help service the grids and effectively expand the break, should there be a forest fire.

Ms. KIMBELL. As I understand it, there is an environmental analysis going on over many parts of California and other places looking at exactly this question.

Mrs. NAPOLITANO. I am talking about Colorado. I am talking all the way down to Wyoming because we flew all the way through.

Ms. KIMBELL. The discussion I was involved in, most recently, had to do with California, but, certainly, I know that there are applications in to be able to widen those rights-of-way along different transmission lines, especially through heavily forested areas with tall trees.

Mrs. NAPOLITANO. Correct.

Ms. KIMBELL. That environmental analysis is ongoing.

The regional forester in the Rocky Mountain Region is here in town this week, but he was actually discussing this just last week.

Mrs. NAPOLITANO. Is there better coordination between the agencies that would allow for faster, say, working on the studies?

Ms. KIMBELL. I will absolutely check on it. I am not aware that there is an issue between agencies, but I will check on that.

Mrs. NAPOLITANO. Would you inform the Subcommittee, please?

Ms. KIMBELL. You bet.

Mrs. NAPOLITANO. It is essential since we are looking at the same issues that would hamper California, as well as other states.

I looked at some of the information I was given, and it goes to the effects of climate change in the West, past outbreaks. I can also attest to the quagga mussels and the zebra mussels. Aside from the pine beetle, looking at those, what are the agencies, in collaboration, doing to research and come up with a way of being able to quell these outbreaks?

Climate change is not going to change from what we are seeing, so we can expect more. What are we doing to be able to address these issues?

Ms. KIMBELL. Well, the mussels one is very, very interesting. I know that the Forest Service is working with a number of different partners addressing the transfer of different invasive species from one water body to another, and I think Mr. Armstrong probably has something to offer to that discussion.

Mrs. NAPOLITANO. Quagga and zebra, both.

Mr. ARMSTRONG. Right.

Ms. KIMBELL. Absolutely.

Mr. ARMSTRONG. The U.S. Fish and Wildlife Service, in combination with the U.S. Geological Survey, the Great Lakes Coalition on Certain Invasive Mussels in the Great Lakes, but in also marine waters, is looking at the issue of invasives and their impact related to climate change.

Mrs. NAPOLITANO. But how long are they going to look at it? You are doing already some studies.

Mr. ARMSTRONG. A lot of work is already going on at the state level to develop adaptation strategies, going back to——

Mrs. NAPOLITANO. Right. Well, it is not just adaptation; I believe you found some kind of bacteria.

Mr. ARMSTRONG. There are mitigation strategies, too, with daughterless technologies and other scientific methods, to prevent the spread and to actually eradicate the invasives.

Mrs. NAPOLITANO. Right. Well, we were in the research and development center also, where we talked to some of the people who are doing the research. The problem is, how long is it going to take? Can we help expedite? Do you need additional funding? What do you need to be able, because it is costing some of the entities millions, if not billions, of dollars, to address the quagga mussels because they are clogging the pipes, and, I am sure, when you do one, you should be able to do others.

Mr. ARMSTRONG. I do not want to give you a figure offhand, just off the top of my head. What I would like to do is get that information for you from our folks at the Fish and Wildlife Service and the GS and get it on the written record and get that statement to you.

Mrs. NAPOLITANO. Well, this is the forest disruption resulting from warming and increased pest outbreaks. That would include the pine beetle and any other invasive species that we might want to do.

You might also want to look at—there is some cane in the resacas in Brownsville that are also affecting the ability of water to be able to be utilized properly. I mean, I can go on, Mr. Chair.

There are so many things that I would love to be able to work in tandem with your Subcommittee because these are issues that just overlap, and unless we know what you are doing, we are not

able to be able to ask for funding or assistance or be able to help you address these things.

Mr. ARMSTRONG. As I said, we will get back to you with a comprehensive assessment of what we are doing and what we need to do in order to deal with the problems of the invasive species and climate change.

This gets back to what Chief Kimbell was talking about before. There is a symbiosis here of wildland fire and forest fire, as well, with the spread of secondary pests and invasives, as well, not just the pine bark beetle but invasive plants and other animals, as well, and we are working, in cooperation with the U.S. Forest Service and other agencies, to try to develop plans to deal with these effects.

Mrs. NAPOLITANO. And that leads to biofuel that you were talking about being able to utilize that as a way of being able to take those dead trees and be able to utilize their wood, if you would.

Mr. ARMSTRONG. Right. I would like to point out, on that issue, going back to what Chief Kimbell talked about, Secretary Salazar is developing a DOI Renewable Energy Task Force which will deal with issues like the transmission lines that you mentioned before, but also biofuel issues and other renewable energy sources.

Mrs. NAPOLITANO. Mr. Chair, thank you very much. I do not have anything to yield back, but I certainly look forward to working with you on this issue.

Mr. GRIJALVA. Thank you so much. Mr. Inslee?

Mr. INSLEE. Thank you. It is good to see my good friend, Billy Frank, here, and I think it is a timely hearing. I met, this morning, with Henry Cagey of the Lummi Tribe, who was telling me about this disaster with the loss of the runs, the Fraser River salmon runs, that has been declared a disaster by the Secretary of Commerce. It may be associated with climate change with the different circulation patterns of water temperature that cause those runs to take a different route from the Fraser River.

Then, this morning, I met with Vaughan Sharp of the Quinault Tribe, who is fed in the Quinault River by the Anderson Glacier. We actually have a picture here showing how the Anderson Glacier has shrunk to almost insignificance in the last 30 years.

We have changes, you know, in our neck of the woods that are affecting the tribes, and my take on this is that, no matter what we do from a land use policy, no matter what we do from even a tribal policy, unless we get a handle on carbon dioxide emissions, we are all in this soup together. And the people who care about pine beetle kills need to help us develop a cap-and-trade system and a renewable electrical scanner system so we can stop putting so much carbon dioxide into the atmosphere; otherwise, we are all in this soup together.

That is just kind of a general question. I just wonder if you have any comments in that regard.

Mr. FRANK. Thank you, Mr. Inslee. You know, the Fraser River is a giant river in the Great Northwest, and the climate change has been part of the problem, the beetles have been another part of them, the siltation of the floods.

The Fraser River is not like the Nisqually River, where I live. The Nisqually River is 90 miles long, and it comes out of a moun-

tain. The Fraser River depends upon the snowfall and the melt and the temperature of that great river. There is a lot of difference right there.

So you have the temperature cooling and the temperature warming, and, you know, it is devastating to the sockeye salmon. The sockeye salmon go up into the lakes and spawn up in that beautiful country up there in British Columbia, and, you know, it goes back to, we are beyond the turning point of global warming right now, and something has got to be done.

This is a real thing that is happening out there, and we are all talking about it, but the status quo has got to change. The status quo of us, the government, the states. The State of Washington alone puts in less than 2 percent of their budget on natural resource. What does that tell you? Less than 2 percent on natural resource. I do not know what the Federal government does on their budget on natural resource. That tells you nobody cares about natural resource, and if nobody cares about natural resource, there is not going to be education, there is not going to be no economy, and there is not going to be cutting any trees down. Mills will be closing, and they are closing right now.

Mr. INSLEE. Mr. Chairman, some people do care about it. We just invested \$70 billion in the stimulus package to try to develop a clean energy economy so that these problems will not happen.

If I can ask Ms. Kimbell, if a person here in Congress really cared about the death of these trees, and I certainly do—I was in the Sawtooth a couple of weeks ago seeing the devastation there and the pine beetle—would you recommend that we find a way to reduce CO₂ emissions so that we can stop climate change so we can stop the predation going on in the forests? Is that the most important thing we could do to prevent this loss?

President Obama has called for a cap-and-trade system and a renewable electrical standard and a variety of methods to reduce CO₂. What would you say about that?

Ms. KIMBELL. I do not think we have time to do one without the other. I think we need to be thinking about forest health while we are addressing CO₂ emissions. Forests currently sequester 10 percent of the carbon that we produce in the United States, and if we can help forests sequester even more than the 10 percent they currently sequester, we will all be better off. Forests are the lungs of the earth. There is a lot of work we can do with forests to help them be better lungs for us while we are also addressing the total carbon emissions.

Mr. INSLEE. But would you agree, we can spend the entire Federal budget on forest health, but if CO₂ levels get to 900 parts per million in the atmosphere, with the enormous climate change that would be associated with that, we are not going to save these forests.

Ms. KIMBELL. I think we have a lot of opportunity to save these forests while we are also working on the President's proposed cap and trade.

Mr. INSLEE. I think I hear a "yes" in there somewhere, that you think we have to do a cap-and-trade system if we are going to save these forests, or something to stop the CO₂ rise.

Ms. KIMBELL. While we are also addressing forest health.

Mr. INSLEE. Right. Thank you.

Ms. KIMBELL. Thank you.

Mr. GRIJALVA. Thank you very much. Question?

Mr. COFFMAN. May I ask?

Mr. GRIJALVA. Sure.

Mr. COFFMAN. The ability of the forests to sequester carbon; you know, when we look around the globe, there has been so much deforestation, there has been such horrible land-management practices, looking at Brazil and what they have done.

I mean, the fact is, could we not offset a great deal of our carbon emissions by promoting not just healthy forests but a reforestation, not just in the United States but globally, through our foreign policy, and would that not make a significant difference when we talk about issues like global warming?

Ms. KIMBELL. Certainly, afforestation and reforestation are important parts of any address to forestry as a part of our address to climate change. Both here in the United States and internationally, the Forest Service is involved in almost every continent, working with different nations, working with different natural resource management issues, and the health of forests is really critical amongst them.

We do work in Brazil, where we have actually worked with people on low-impact logging. We have looked at the different kinds of gases emitted by different kinds of forests in Brazil. I would not trade places with some of the issues that they have in Brazil right now in trying to address that whole social issue, all of the social questions, around how to manage the Amazon. They have some real tough issues that they are up against.

But the Forest Service is working with a number of other nations in looking at forests, forest health, afforestation, as well as reforestation, and we need to be working on that right here at home as well.

Mr. GRIJALVA. Thank you, and thank you, Mr. Coffman.

We are going to recess. We have a vote that is going on. Let me thank the panelists, and also, you know, the issue of wildfire came up over and over today from the Members.

I and Chairman Rahall will be reintroducing the Flame Act one more time. I would suggest to my colleagues to look at the piece of legislation so that we do, on the issue of fire suppression, create a different funding stream so that much of the money that is now being used by the Forest Service can be used for reforestation, better stewardship, et cetera, et cetera.

So thank you very much, and we should be back within 35 to 40 minutes. Thank you.

Ms. KIMBELL. Thank you, Chairman.

[Whereupon, at 3:40 p.m., a short recess was taken.]

Mr. GRIJALVA. We will reconvene the oversight hearing today. We just finished those votes. Those are the last votes for the day. Some of my colleagues might or might not return, but all of the comments that you have, and any responses to any questions I may have or Mr. Bishop may have, will all be part of the record, and if there are additional questions, colleagues will submit them to us, and we will forward them to you for a response. So I appreciate your indulgence, and I am looking forward to your comments.

Let me begin with Mr. Eugene Spiering, Vice President for Exploration, Quaterra Corporation. Sir, your comments.

STATEMENT OF EUGENE SPIERING, VICE PRESIDENT FOR EXPLORATION, QUATERRA CORPORATION, KANAB, UTAH

Mr. SPIERING. Thank you, Mr. Chairman. My name is Eugene Spiering. I am the Vice President of exploration with Quaterra-Alaska.

What I would like to say is that the Federal lands could have a dramatic role in combating climate change while decreasing our nation's dependency on foreign energy supplies if, and only if, these lands are managed to encourage and promote uranium mining and the production of nuclear energy.

Although wind and solar energy may represent important components of an equation toward the mitigation of carbon dioxide emissions, the large-scale application of these techniques will result in a massive degradation of Federal lands and leave a lasting legacy of a failed government program that will embarrass its supporters and infuriate future generations.

Twenty percent of this nation's electrical energy is generated by 103 reactors producing 100,000 megawatts of electricity. Palo Verde, a single generating station located 45 miles west of Phoenix, produces 3,800 megawatts of clean, nonpolluting electrical energy, or approximately 3.8 percent of this nation's consumption. This power station uses only wastewater from the City of Phoenix for cooling, stores all high-level, radioactive waste on site, and, with all attendant facilities, disturbs a total surface area of 4.5 square miles.

To produce an equivalent amount of energy by wind generators would require a disturbance of 760 square miles, and solar panels would require 190 square miles. The amount of land disturbed by solar- and wind-generating systems is enormous when you compare it to nuclear powerplants. Wind generators have an average operating capacity of 25 percent compared to 97 percent by nuclear plants.

When considered with land-disturbance caused by thousands of miles of powerlines and hydroelectric storage facilities for this intermittent power, the total disturbance of wind power is approximately 160 times the total disturbance of nuclear energy for a similar generating capacity.

Solar energy disturbs over 40 times the surface area of nuclear power and costs over five times more per kilowatt hour.

If 20 percent of the electrical power used by the U.S. was produced by wind energy, the facilities would cover a surface area of 20,000 square miles, an area slightly less than the entire State of West Virginia. Because the efficient use of wind generators requires a location along hilltops and ridgelines, more than 80,000 miles of horizons in the U.S. would be bristling with windmills and powerlines, a sight that many would not like to experience.

As the wind generators reach the end of their estimated 25-year life, maintenance may no longer be feasible or possible due to changing economic or political environments, and thousands of miles of rusting junk will remain as a monument to yet another failed energy policy.

The U.S. will remain dependent on foreign energy during the waning phases of the world's oil production. The Executive Secretary of the Intergovernmental Panel on Climate Change, set up by the United Nations, stated, at Bali, that "I have never seen a credible scenario for reducing emissions that did not include nuclear energy."

A recent British white paper on nuclear power concluded that "nuclear power is the most cost-effective, low-carbon-generation technology available."

There are now 196 nuclear powerplants with a net capacity of 170,000 megawatts in operation in Europe. There are 14 new units under construction, and moratoriums against building new reactors and mandatory phaseouts of existing nuclear-generating facilities are being lifted in Switzerland, Sweden, Italy, England, as well as several Eastern European countries.

Approximately 80 percent of France's electric energy is now generated by nuclear power. Thirty-three reactors are currently under construction globally, and 94 are estimated to either be on order or in the advanced planning stage. There are proposals for an additional 222 reactors.

This is the way the world is responding to the climate change and energy. If the U.S. truly wants to use public lands to fight global warming without the disturbance of enormous land areas and thousands of miles of scenic vistas, the only effective and cost-efficient manner is to encourage and promote uranium mining and the production of nuclear energy on Federal lands.

This is truly an issue that transcends politics. Nuclear energy is critical to the economy and future well-being of our nation. Thank you, Mr. Chairman.

[The prepared statement of Mr. Spiering follows:]

**Statement of Eugene D. Spiering, Vice President of Exploration,
Quaterra Alaska Inc.**

Federal Lands could have a dramatic role in combating climate change while decreasing our nation's dependency on foreign energy supplies if and only if these lands are managed to encourage and promote uranium mining and the production of nuclear energy. Although wind and solar energy may represent important components of an equation toward the mitigation carbon dioxide emissions, the large scale application of these techniques will result in a massive degradation of Federal lands and leave a lasting legacy of a failed government program that will embarrass its supporters and infuriate future generations.

Twenty percent of this nation's electrical energy is generated by 103 reactors producing 100,000 megawatts of electricity. Palo Verde, a single generating station located 45 miles west of Phoenix, Arizona produces 3800 megawatts of clean, non polluting electricity or approximately 3.8 percent of our nation's consumption. The Palo Verde power station uses only waste water from the city of Phoenix for cooling, stores all high level radioactive waste on site, and with all attendant facilities disturbs a total surface area of 4.5 square miles. To produce an equivalent amount of energy by wind generators would require a disturbance of 760 square miles and solar panels would require 190 square miles.

The amount of land disturbed by solar and wind generating systems is enormous when compared to nuclear power plants. Wind generators have an average operating capacity of 25% compared to 97% by nuclear plants. When considered with land disturbance caused by thousands of miles of power lines and hydroelectric storage facilities for the intermittent power, the total disturbance of wind power is approximately 160 times the total disturbance of nuclear energy for a similar generating capacity. Solar energy disturbs over 40 times the surface area of nuclear power and costs over 5 times more per kilowatt hour.

If 20% of the electrical power used by the U.S. was produced by wind energy, the facilities would cover a surface area of 20,000 square miles; an area slightly less

than the entire state of West Virginia. Because efficient use of the wind generators requires a location along hill tops and ridge lines, more than 80,000 miles of horizons in the U.S. would be bristling with wind mills and power lines; a sight that many would not like to experience. As the wind generators reach the end of their estimated 25 year life, maintenance may no longer be feasible or possible due to changing economic or political environments and thousands of miles of rusting junk will remain as a monument to yet another failed energy policy. The U.S. will remain dependent on foreign energy during the waning phase of the world's oil production.

The Executive Secretary of the Intergovernmental Panel on Climate Change (set up by the World Meteorological Organization (WMO) and by the United Nations Environment Program) stated at Bali that: "I have never seen a credible scenario for reducing emissions that did not include nuclear energy."

A recent British White Paper on nuclear power concluded that nuclear power is the most cost effective low-carbon generation technology available. Volatility in oil prices and the clash between Russia and Ukraine over gas pipelines has made nuclear power—with virtually zero carbon dioxide emissions—a more attractive option for Europe. There are now 196 nuclear power plant units with a net capacity of 170,000 MW in operation in Europe and 14 new units with under construction in five countries. Moratoriums against building new reactors and mandatory phase outs of existing nuclear generating facilities are being lifted in Switzerland, Sweden, Italy, and England as well as several eastern European countries. Approximately 80% of France's electrical energy is now generated by nuclear power. According to BHP Billiton, 33 reactors are currently under construction globally, another 94 are estimated to be either on order or in the advanced planning stage while there are proposals for a further 222 generators.

There are those that want to stop uranium mining in the U.S. and fear the use of nuclear power. This is understandable considering the amount of misinformation cited in newspapers and editorials by a few activists. Why should we trust this industry? Perhaps we should try to inform ourselves on how the rest of the world is dealing with these issues and learn why so many of the world's scientists are encouraging the use of nuclear energy. Gwyneth Craven in a recently published book titled *Power to Save the World: The Truth About Nuclear Energy*, published by Alfred A. Knopf, a division of Random House, Inc., 2007, provides a well-researched and readable examination of nuclear energy from mining and energy production to the final storage of waste.

If the U.S. wants to use public lands to fight global warming without the disturbance of enormous land areas and thousands of miles of scenic vistas, the only effective and cost efficient manner is to encourage and promote uranium mining and the production of nuclear energy on Federal lands. This is truly an issue that "transcends politics". Nuclear energy is critical to the economy and future well being of our nation.

Mr. GRIJALVA. Thank you, sir. I appreciate your comments.

Dr. Mark Harmon, Richardson Chair and Professor in Forest Science, Oregon State University, welcome, and I look forward to your testimony.

**STATEMENT OF MARK E. HARMON, Ph.D., RICHARDSON CHAIR
AND PROFESSOR IN FOREST SCIENCE, OREGON STATE
UNIVERSITY, CORVALLIS, OREGON**

Mr. HARMON. Thank you, Mr. Chairman and Subcommittee Members, for inviting me to testify. My name is Mark Harmon. I am a professor at Oregon State University. I am here to represent myself.

I have studied the problem of carbon in forests for almost three decades, published numerous articles, conducted lots of studies, and taught courses on the subject. I am here to provide information and insights.

U.S. forests currently offset about 10 percent of the nation's greenhouse gas emissions. They could be managed to offset more—perhaps that amount could be doubled so we could gain another 10 percent—but it would be part of a bridging strategy.

So forests cannot solve the entire problem, and they can only help for a limited time, say, about 50 to 100 years, but this is still a significant contribution to the issues we face.

There are many misconceptions about carbon in forests. Many proposals are based on these misconceptions, and they are going to prove counterproductive.

There is a tendency to only look at the inputs to the forest system or the outputs, depending on what people are trying to sell. I think this is really misleading. As scientists, we have to look at what is coming in and what is going out simultaneously.

A good analogy for carbon in a forest is like a leaky bucket. A leaky bucket can store carbon, but you have to have carbon coming in, and the amount that stays in depends on the number and size of the leaks. So if we want more carbon in that carbon bucket, we have to put more in at a higher rate, or we have to do something to alter the nature of those leaks.

How do we decide what to do? There are a lot of proposals out there. Well, this is sort of like buying a house, but instead of checking for dry rot, we need to check for a few other things.

For example, are all of the carbon stores being counted? There is a tendency to leave out key pools in the analysis.

Has a starting point been specified? How do we know where we are going on any journey if we do not know our starting point, and we do not know how far or what direction?

How long will it be until the project pays off? Forests are slow systems. They have time lags. Many of the projects that are proposed will pay off perhaps in centuries, and we really need a quicker solution.

Are the practices truly renewable? Forests are potentially a renewable resource, but it depends on how they are managed.

What other processes will occur when we take an action? For every action, there is an opposite reaction, so how will that affect what happens?

Finally, how does this policy work over a large area and over a long time period? We have to evaluate projects in that way.

Now, there are a number of actions that will work, and there are some that will not work. Stopping or slowing deforestation will definitely work. Afforestation—that is, adding forests to areas that once had forests and now do not; that definitely works.

Lengthening the interval between disturbance to harvest actually increases the amount of carbon stored in a forest. Likewise, taking less each harvest or each disturbance leads to more stores. This is like plugging the holes in the leaky bucket.

A couple of things that simply do not work: Converting old-growth forests to younger plantations simply does not store more carbon. You are taking a system with high carbon stores, converting it one-to-one with lower. There is no way you go from here to there without losing carbon. It is that simple.

Now, I have a number of concerns. One is carbon is not the only reason we are managing forests. We clearly need a balance. We heard about treatments for fire fuels and reducing those. Studies are showing that that actually does not save much carbon. It actually emits more carbon, treatments do, than the fires do themselves.

However, we need to protect people's homes. We have to have defensible zones. We need to restore some ecosystems back to their original structure. Those are very good reasons to be harvesting and doing treatments, but, from the carbon perspective, they are not.

We need a thoughtful, transparent, accounting system that does not have unintended consequences, and some schemes do have these consequences. We need a reliable monitoring system that can be verified independently.

And, finally, one last comment is that continued climate change really endangers forests serving as places to store carbon. If we wait too long, we are actually going to have forests become part of the problem and part of the solution, and that is one of my greatest concerns that I have.

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Harmon follows:]

Statement of Mark E. Harmon, PhD, Richardson Endowed Chair and Professor in Forest Science, Department of Forest Ecosystems and Society, Oregon State University

Introduction

I am here to represent myself and offer my expertise to the subcommittee. I am a professional scientist, having worked in the area of forest carbon for nearly three decades. During that time I have conducted numerous studies on many aspects of this problem, have published extensively, and provided instruction to numerous students, forest managers, and the general public.

Recently there has been an increasing interest in using forests as a way to remove carbon from the atmosphere and store it over the long-term as part of a greenhouse gas mitigation strategy. U.S. forests currently remove an equivalent of 12% of this nation's carbon dioxide emissions; there is excellent potential to increase and maintain this carbon "offset" as part of a bridging strategy. The following testimony reviews, in terms as simple as possible, how the forest system stores carbon, the issues that need to be addressed when assessing any proposed action, and some common misconceptions that need to be avoided. I conclude by reviewing and assessing some of the more common proposals as well as my general concerns about the forest system as a place to store carbon.

My key points: 1) Forests are leaky carbon buckets, 2) Forests can play an important, but limited roles in sequestering carbon, 3) All carbon pools need to be examined when thinking through the merits of carbon policy, 4) To increase the sequestration of forest carbon, we need to either increase carbon inputs, decrease carbon outputs, or put forest carbon somewhere else, 5) Forests are best seen as a bridging strategy in carbon mitigation, 6) Seemingly "good" forest carbon ideas when examined at the stand level at a point in time dissipate when looked at the forest level over time, and 7) With accelerating climate change, forests may shift from being part of the carbon solution to being part of the carbon problem.

The Basic System: Forests as Leaky Carbon Buckets

Carbon is stored in multiple ways in the forest system: in the forest itself and the carbon harvested from the forest. Living plants store carbon above- and below-ground. The longer lived the plants or their parts, the more that they store. This is why forests contain more live carbon than grasslands: their parts have longer lives. When plants or their parts die they start to decompose, but some carbon can be stored as dead biomass. The slower the decomposition rate, the more that will be stored. This is why dead wood in a forest can be an important carbon store. Decomposition of dead plants eventually leads to the formation of soil carbon, which due to its relatively slow decomposition rate can accumulate to high levels. So despite a low live carbon store, grassland can store a great deal of carbon in the soil because it produces many dead roots that end up as soil. Harvest of wood and bark can also store carbon, but as with other parts of the forest system, it is subject to carbon losses, specifically during manufacturing, use, and disposal. In the case of biomass energy, the harvested carbon is theoretically stored as unused fossil fuel carbon. Given the longevity of carbon dioxide in the atmosphere and the fact that

this fossil fuel carbon may be eventually burned, “carbon” biomass energy must delay the use of fossil fuels for many decades to be an effective storage mechanism.

Photosynthesis, respiration, and combustion are the major processes that control how much carbon enters and leaves the forest system. These processes interact to control the carbon store of forest systems. Forests are biological systems and as such are “leaky” with regards to carbon. That is, there is one way in which carbon comes in (photosynthesis) but many ways it goes out (respiration of plants, decomposers, and consumers, combustion, leaching, and erosion). A key concept to understand is that leaky systems can store carbon, but the amount they store is related to the amount that is coming in versus the proportion that is leaking out. By analogy a bucket with leaks can store water, but to do so it needs a constant input of water. However, the larger the leaks the less water that is stored regardless of the amount of flow into the bucket. The same can be said of a bank account; one can spend money and still accumulate wealth as long as money is put into the account. Returning to the forest system, photosynthesis is constantly causing carbon to flow into the bucket or account. Increasing the input of carbon by increasing the rate of photosynthesis will increase the average forest carbon store. Decreasing the respiration rate of plants or decomposers or the losses from combustion will also increase the average forest carbon store. However, regardless of cause these net increases will eventually slow and then cease as the forest system comes to a new balance.

Disturbance, be it natural or human-induced, influences the balance of carbon several ways. Some disturbances, such as fire, directly release carbon to the atmosphere. All disturbances convert living plant biomass into dead biomass, subjecting the forest system to additional respiration losses (essentially more leaks). Disturbance temporarily reduces photosynthesis; which means that the average carbon input to the system is decreased by disturbances because it takes some time to restore the photosynthetic capacity of forests. The effect of disturbance depends on the frequency and the severity (i.e., amount of carbon removed) of the disturbance. The more frequent disturbances appear in forest systems, the more that is removed, and hence less carbon is stored on average. Decreasing the interval between disturbances effectively increases the number of leaks in the bucket. The same effect is true for disturbance severity; the more severe the disturbance is in directly removing carbon, the less stored on average. Increasing disturbance severity effectively increases the size of the leaks in the bucket.

The Effects of Natural Disturbances versus Harvest

Whether trees killed by fire or windstorm are salvaged makes relatively little difference in carbon storage. Whenever there is a natural disturbance it is often suggested that harvesting dead trees will release less carbon than letting them decompose naturally. This is based on the assumption that natural processes will rapidly release carbon and timber harvesting will not. This assumption is not supported by the likely rates of carbon release from these two processes. Setting aside the fact that harvest and transport of wood currently requires carbon-based energy, there is an inevitable release of carbon during the manufacturing and use of forest products. Depending upon the type of wood product produced, the amount of carbon released during manufacturing is equal to 25-50% of the harvested amount. In many cases harvested forests are burned for site preparation, a process that removes approximately 5-10% of the forest's carbon. Combined with manufacturing losses, this means that timber harvest reduces total forest carbon stores by 10-25%. When products are in use, their life-span has a wide range from less than several decades to centuries. This yields a rate of loss of between 1 and 10% per year. While surprising, these values are not that different for natural disturbances. Consider the amount of loss during a fire, the natural disturbance that removes the most carbon. A common assumption is that much of the wood burns in a fire, although if that were true there would be no debates about salvaging wood. Analysis after fire indicate that, while small material can be totally consumed, it is rare that harvest sized wood is consumed. Losses from roots and the soil are minimal. Taking all the carbon stores of a forest into consideration, the range of carbon losses from fire consumption is probably between 5 and 15%, generally lower than range for timber harvest and products manufacturing. After the fire, the newly killed trees decompose. For the US, the range of wood decomposition rates for the size of material harvested is between 1 and 10% per year. That is very similar to that of forest products! Although all these numbers are approximate, they do indicate that salvaging fire-killed trees is not substantially better for carbon storage than simply allowing the trees to decompose, and in certain situations might be considerably less effective in storing carbon.

Things to Consider: Framing the Analysis of Carbon and Forests

There are a number of general things that should be examined whenever an action regarding carbon and forests is considered. Unfortunately this has not always been the case.

1. All the relevant carbon stores need to be examined. Many projects are considered from the point of view of just live carbon. This may be quite natural to do as we have the most data and understanding of live trees. However, it must be realized that other important carbon stores in forests do not behave the same as live trees. Dead trees, for example, often reach their highest store after disturbance, whereas live trees reach their lowest store at that point. By only considering live plants it is highly likely that the rate of forest carbon uptake is overestimated, in some cases by substantial amounts. A related issue is that the changes in all the carbon pools need to be considered for a total accounting. For example, harvesting wood does increase stores in the wood products pool, but it also decreases stores in the live and dead wood pool in the forest.

2. The starting conditions are key and yet are often ignored. The starting and end points need to be specified. Often a proposed action gives the end point, but not the starting point. This would be similar to describing a trip by only giving the destination. One will have no idea of the direction or the distance to be traveled. For example, if one is planning on establishing a short-rotation forest plantation on agricultural land, then more carbon will be stored. Establishing the same type of plantation by converting an old-growth forest will result in a net loss of carbon to the atmosphere.

3. Our actions to increase carbon stores can take decades to have a positive effect. Not every action in forests leads to an “instantaneous” response. It takes time to implement policy actions because the area involved is quite large. This means that the effect of any proposed policy needs to consider the long-term: many decades to centuries. Once treated forests take many years to adjust to any action that is imposed. For example, it takes years to decades for a planted forest to establish full photosynthetic capacity. It also takes years to decades for the dead material created by a disturbance caused by nature or humans to decompose away. This means that temporal lags can be expected in any projected gains. Thus, it may be eventually possible to gain carbon by converting an older forest to a younger biomass energy plantation, but it may take many decades or even centuries for this to occur. This is time we do not have.

4. Forests are potentially renewable, but this is not a fixed property of forests. It is generally assumed that forest related carbon in the form of wood and biofuels are renewable. There is logic to this in that trees can be harvested and can regrow. Resources that can regrow are potentially renewable, but a resource is not renewable automatically because it is grows or is a tree. To determine if a resource is renewable we need to compare the regeneration and removal rate. We also need to understand that removal of trees can and does affect carbon pools other than trees and these can decline when trees are harvested. Given we are considering the entire forest carbon system, this means that harvesting a renewable resource such as trees leads to a non-renewable loss elsewhere in the carbon system.

5. Forests are systems that have feedbacks which can strongly influence carbon effects of actions. For example, increasing the growth rate of trees can lead to higher carbon stores in forests, but a larger live tree store also means that more plant material will die during the course of forest growth or harvest. More dead plant material means more losses via decomposition or combustion if there is a fire or harvest. This means that the gains from increases in forest growth feedbacks to result in decreased net carbon increases in time. As another example, it has been stated that forest fire frequency and severity will increase in the future. That may be the case, but it also should be noted that it is generally difficult to increase the severity and frequency of fires for any length of time, in part because more frequent fires eventually lower the fuel level, and fuel level is related to fire severity.

6. Estimating carbon effects of policies need to look at whole forests over time, not single stands at a point in time. The way a forest system behaves depends on how large an area that is considered and how long a time period it is considered. Perhaps no other issue, termed scale by ecologists, has lead to so much confusion and frankly wrong-headed notions in terms of forest carbon management. It is perfectly true that young forests of a certain age do remove more carbon in a course of a year than an older forest. This would be useful information if forests never changed their ages. The high rate of uptake of some young forest occurs because even younger forests have lost carbon. Since one cannot have a young forest without have an even younger forest, comparing the just one year in the life's forest is completely misleading. Recall that when forests are disturbed by nature or hu-

mans the forest initially loses carbon. Over a long time period forests gain carbon and eventually lose some of it when disturbed again. If the average carbon stores of a young forest is compared to that of an older forest, then one finds that the older forest stores a good deal more carbon. Therefore one is unlikely to gain carbon from the forest site if one converts from an older to a younger forest system. When one considers a small plot of land, the carbon balance seems to moving from losing to gaining to losing carbon over time. However, when one considers many plots of land that are going through these cycles at different times, then one sees a relatively steady store of carbon. This is analogous to a bank in which one person puts in funds and another removes them. As long as there is not a run on the bank, the amount of funds is relatively constant (at least that is the hope). This is quite relevant in terms of carbon policy, because small land owners will see boom and bust cycles in their carbon stores and this may make buying their carbon credits very unappealing. If many small land owners aggregate their carbon projects, then it is possible for the buyer to see a steady store or supply of carbon.

Using Forests to Sequester Carbon from the Atmosphere: increase carbon inputs, decrease carbon outputs, or put forest carbon somewhere else

US forests are currently removing carbon from the atmosphere and are likely to remain doing this for some time, perhaps decades. Eventually, as in all leaky systems, the rate of carbon removal is likely to slow and eventually cease. At this point the forest will be in rough balance with the amount coming in about equal to the amount going out. This "saturation" behavior is one reason forests are considered a bridging strategy and not a lasting solution to the problem of reducing greenhouse gas emissions.

To continue and enhance the removal of carbon by forests, it will be necessary to take direct actions. Put simply, to remove more carbon from the atmosphere with forests it will be necessary to increase the average amount of carbon that forests store or increase the efficiency or manufacture of wood products and the length of their storage in use. As stated above, the average carbon store as well as the carbon balance of any forest is controlled by the amount input via photosynthesis versus the amount lost via respiration (e.g., plants and other organisms such as decomposers) and the amount lost via combustion. Both the average carbon store and the carbon balance vary over time, in part, because the factors controlling photosynthesis, respiration, and combustion vary over time. Therefore it is useful to distinguish between short-term and relatively minor variations in forest carbon caused by yearly variations in climate versus those caused by changes in policy or long-term changes in climate. It is the latter two that will change the balance and store of carbon in the long-term.

Before presenting the range of possible management options it is worth reminding ourselves that carbon is not the only reason we manage forests. Forests provide humans clean water, habitat for many animals, plants, and other organisms, harvested goods of all sorts, recreation, and many intangible benefits. Not all these objectives will be compatible with maximizing carbon stores in forests. Moreover, there are certain management actions such as thinning certain forest types (e.g., Ponderosa pine) that may be necessary to maintain these forests despite the fact that carbon stores will be decreased. We cannot be so single minded about carbon that we create a host of other problems.

There are many proposed steps and multiple viable strategies and that can be taken with regard to increasing forest carbon. Admittedly this can be confusing for those looking for a "one-size fits all" approach. On the other hand it does offer flexibility that will allow one to tailor approaches with specific situations on the ground. **Essentially one can increase carbon stores of by increasing the input to the forest, decreasing the output from the forest, putting the carbon from the forest somewhere else, or some combination of these.** The following reviews specific approaches that have been proposed recently:

1. Slowing that rate of deforestation (i.e., the permanent removal of forests) will definitely slow the release of carbon to the atmosphere. Depending upon the period examined, deforestation is estimated to have added 20-30% of the increased carbon dioxide in the atmosphere since the dawn of the industrial revolution. While deforestation for agricultural purposes is generally low in the US, considerable forest land is being converted to housing and industrial use, which can have the same effect as deforestation, particularly if clearing is extensive.

2. Planting new forests is generally a good practice to increase carbon stores, particularly on lands that once held forest many years ago. Much of our nation's current forest-related carbon removal from the atmosphere is associated with the reestablishment of forests in the eastern U.S. after agricultural abandonment. The best opportunities are on marginal agricultural lands as the impact on

food production is reduced. Planting forests on degraded agricultural land can increase the store of carbon both above- and belowground (i.e., soils). Forests can also be reestablished on lands with low stocking of trees after regeneration failures. Planting trees on what have been traditionally grassland systems can lead to reductions in soil carbon stores, in part because trees do not produce as many dead roots as grasses. Care needs to be taken in assuring that these losses belowground do not exceed those gained aboveground.

3. Biomass energy has the potential to offset fossil fuel use and hence reduce carbon release to the atmosphere under certain conditions. However, there are several factors that must be considered before this potential is realized. Biomass energy is not necessarily renewable; it is only renewable when the resource is allowed to fully regenerate. Forests, by their very long-term nature, take years to regenerate their biomass and one cannot assume that all forest practices lead to a renewable resource. When using biomass energy, it must be borne in mind that one is substituting energy and not carbon. Because biomass contains less energy per unit carbon than fossil fuels, some fossil fuels are required to produce the same amount of energy, and so removal of one unit of carbon from the forest results in less than one unit of fossil carbon from being unused or stored. It therefore may take several cycles for carbon benefits to accumulate to the point that they offset losses in the forest. This is why the carbon benefits of biomass energy can be delayed if natural forests storing a more carbon are converted to plantations that store less carbon. This suggests that if biomass energy is to be part of a forest strategy, it is best employed with afforestation efforts or in forests that are already young. Although it is usually assumed that fossil fuel use is decreased when biomass energy is used, this is not necessarily true. Given the lifespan of carbon in the atmosphere, the delay in fossil fuel use has to be substantial to be effective. Simply delaying the use a few years does little to reduce the rate of overall carbon emissions. The argument that the increase in fossil fuel related carbon would have been worse without biomass fuels would have merit if the issue was to just slow the increase in these releases. However, the issue that confronts us is how to decrease the current release rate of fossil fuel carbon.

4. Converting older forests to younger forests rarely stores more carbon. Such action increases the leakiness of the forest bucket (recall major losses discussed above in site preparation, manufacturing losses, and the increased frequency of disturbance). An exception is when a frequent natural disturbance is replaced by a less frequent harvest (which by the way rarely happens). Another is when an inherently very slowly growing natural forest is replaced by a much faster growing plantation. That too is fairly rare. Two of the best ways to store more carbon in forests is to extend the interval between harvests or take less per harvest. Basically both actions make the forest bucket less leaky. Depending on the length of the rotation or the amount of harvest, one can either enhance or reduce the store in forest products. While longer rotations can lower the average amount that is harvested, the material that is harvested tends to be more suitable for long-term use and hence may store more as wood products.

5. It is possible to increase forest system carbon stores by increasing the growth rate of trees. Depending on the forest, this can be achieved by using superior genetic stock, planting faster growing species, fertilization, irrigation, or speeding the rate of tree regeneration. In most cases the increases in tree growth do not offset the losses from converting older natural forests, and in all cases it may take several harvest intervals before gains are fully realized in wood products stores. Usually the goal of increasing the growth rate of trees is to shorten the interval between harvests. If this practice is followed, then the gains of carbon in the forest itself will be minimal. On the other hand it may result in increased wood products stores, but that depends on the types of products produced. It should also be noted that thinning of forests does not increase the rate carbon is added to forests. It does allow the remaining trees to grow faster and become larger faster, but one must remember that it does this for fewer trees. The claim that thinning increases forest production is really based on the amount harvested, not the amount of carbon entering the forest: these are two completely different things.

6. Reducing fuels in forests have few benefits from a carbon storage standpoint. Recently it has been proposed that reducing fuels in forests would reduce fire severity to the point that more carbon would be stored in forests than allowing them to burn untreated. This practice can have benefits for ecosystem restoration in some forest types (for example, Ponderosa pine), but there appear to be few benefits from a carbon storage perspective. There are many reasons for this result. First, to reduce fuels one needs to reduce carbon stores, so there would have to be major changes in fire severity and size to offset these losses. Second, the difference in the effects of severity on carbon stores is less dramatic than generally

imagined. As indicated above, a very light fire might result in forest losses on the order of 5% of total carbon in a forest, whereas for an extremely severe fire these losses might be on the order of 15%. Third, one cannot anticipate where fires will occur, so a large proportion of the forest area needs to be treated. In contrast, a small proportion of the forest area may burn in the next few decades, which results in more losses from the treatment than the fires (bear in mind the total effect depends on both the area involved and the average loss per area). The most likely case where removal of fuels will result in a long-term carbon benefit would be if, without fuel treatment, the fire severity increases to the point that tree regeneration is greatly delayed. However, this regeneration delay has to be substantial to have much of an effect.

7. Forest products do store carbon; whether they actually increase the forest system carbon stores is a more complicated issue. Given that the basic material of forest products, wood, is approximately 50% carbon, harvesting wood and placing it into forest products can definitely store carbon. However, this gain is at the expense of storing carbon in the forest, and it is completely possible there will be no net gain in the total forest system carbon stores. Harvest of wood removes carbon from the forest which means the parts of the forest that depended on that carbon will decrease in stores. Manufacturing of wood into products results in a loss of carbon as does the use and disposal of wood products. Overall, the effect of harvesting carbon is to make the overall forest system leakier. If wood products are to be used to store carbon, then the efficiency of converting wood into long-lived products needs to be increased, and the life-span of these products needs to be lengthened considerably (see above). There have been proposals to harvest wood from forests and store it in a location where it cannot decompose by burial on land or sinking it into oceans or lakes. I suppose this would be the “ultimate” wood product in terms of carbon storage. Assuring that there is no decomposition may prove challenging: wood is decomposed quite quickly in oceans, for example, organisms such as shipworms readily eat wood as any naval historian can attest. Wood is not the most concentrated form of carbon and the sheer volume to be stored would likely dwarf those of current landfills and interfere with other land-uses. Also it may not prove particularly popular. Finally, the harvest of wood causes other parts of the forest to temporally lose carbon which would introduce time lags into the gains offered by this scheme.

8. Substitution of wood for more energy intensive materials has the potential to decrease fossil fuel carbon releases, but how much of this potential will be realized is difficult to quantify. It has been proposed that substitution of wood for more energy intensive materials will reduce the rate that fossil fuel carbon is released into the atmosphere. While wood is generally less energy intensive than many alternative materials, the difference between materials has been decreasing and not all the energy for these is supplied via fossil fuels. Currently, steel and concrete utilize three times the energy of wood. However, most buildings are mixtures of wood and other materials, so the energy savings of a building primarily constructed of wood is 30% relative to those primarily made of other materials. As noted above, harvest results in the release of carbon from the forest and while not fossil fuel-related, these losses need to be deducted from any gains. Many homes and small commercial buildings already utilize wood to a high degree. It is therefore not clear how large the substitution effect can become in the US. Finally, although it has been stated by some that the substitution related carbon offset never decreases and accrues each harvest. However, there are reasons to suspect this claim. This would only be true if wooden buildings lasted forever or the supply of buildings increased without limit. It is far more likely that buildings will have a finite life-span and need to be replaced, which also means wooden buildings cannot increase without limits. Since that is true, then in time harvests are maintaining the store in buildings and there is no net gain in this form of carbon offset. So depending on how much carbon is actually offset, this might be part of a bridging strategy.

Concerns

Despite the reality that U.S. forests are currently removing carbon from the atmosphere and the great potential for forests to play a role in offsetting greenhouse gas emissions, I do have several concerns.

Liquidation of forest carbon stores can be the potential unintended consequence of carbon policy. To have forests play a greater role than they do currently, we will have to do something different than business as usual. We must assure that additional carbon is stored due to new actions, a concept usually called “additionality.” Despite the need for this concept, it must be acknowledged that it means those with practices that have led to the lowest carbon stores have the most

to benefit from changing their practices. The role of those that have already changed practices or have always managed in a manner to keep carbon stores high has to be recognized and encouraged. Little will be gained if the only way to have carbon store increases counted is to first lower carbon stores. Given the time lags inherent in the forest system, this will be totally counterproductive.

Making sure carbon stores are real: the need for a national accounting, verification, and monitoring system. We must make sure that any gains in forest carbon stores are real, which means they will have to be monitored and verified. This needs to be done at two levels. The first would be at the level of specific projects. The second would be at a national level, which would involve more than simply adding up all the projects, in part because there will be many forest areas without carbon projects that need to be considered in the national balance sheet. The often stated claim that methods do not exist to monitor changes in forest carbon is completely puzzling given that scientists developed these methods decades ago. There are many existing methods and systems that can be modified to achieve the goal of monitoring and verification. They could be substantially improved with further investments, but are sufficient to start the process now. National guidelines or protocols, similar to those developed by California, would greatly aid in assuring monitoring and verification is trustworthy. At least at the project level, where the goal is to support a carbon credits market, these protocols can be flexible as long as there are discounts or deductions for uncertainty about how much additional carbon is being stored. That way the project managers can decide the tradeoff between the gain in carbon by lowering uncertainty versus the cost of a more expensive and comprehensive measurement program. It should also be noted that these estimates of carbon gains need to be conservative, because failing to count storage will do far less environmental harm than over-counting. Another possible role for the government would be to support detailed studies of proposed projects to fully understand the carbon impacts of the most commonly proposed projects. While there is a great deal of scientific research in this realm, it has not generally been of an applied nature. It is unlikely that all forest projects will be able to afford detailed measurements of all the carbon pools and processes. These studies would allow others to more fully anticipate the likely carbon gains and costs of proposed projects and in fact streamline the verification process because certain practices would have been proven to work under certain conditions. Finally, it is important that a system be established to rank the quality of the carbon as opposed to the quantity of carbon. This might be similar to that used for rating bonds; however, as we have all just learned to work this system needs to be independent of those buying and selling carbon credits.

Despite the potential for forests to contribute to the challenge of reducing our nation's greenhouse gas emissions, I do believe that the forest system's limits have to be fully recognized. Even if we could double the current rate that forests are removing atmospheric carbon, it would amount to approximately 20% of the current fossil fuel release of carbon dioxide. This is quite important, especially since it can be achieved with largely with today's technology. But clearly forests cannot be used to solve the entire problem.

My greatest concern: with continued warming forests can shift from being part of the carbon solution to being part of the carbon problem. Forests cannot continue to accumulate carbon forever, so it can be part of a bridging strategy, but we need to use the time it buys us wisely. This brings me to my greatest concern which involves the role forests will play if the climate continues to warm as projected under a business as usual scenario. If we do not act soon to reduce the rate the carbon dioxide and other greenhouse gases are released, we may create a climate that will make forests start a net release carbon to the atmosphere. This could come about in several ways, but many of the effects are likely to be caused indirectly by increased drying of forests. This will mean that wildfires become more extensive and more severe, that insect outbreaks become more extensive and more severe, and that even trees in so-called "undisturbed" forests start to die at faster rates. If this starts to happen then the leaks from the forest carbon system will increase and eventually less will be stored. Not all the carbon will be released all at once as is often implied, it will happen gradually, but if forests reach this point then they will start to contribute to the problem we are trying to solve. Further, it may also become part of a vicious cycle in which more tree die which releases more carbon which warms the climate even more which causes more drying, which causes more trees to die, etc. Forests are not the only part of the natural world that may act in this manner; thawing currently frozen soils in the north could cause yet another vicious carbon release cycle to begin. To assure that this does not happen we need to act on a number of fronts and to decrease carbon dioxide and other greenhouse gas concentrations in the atmosphere as fast as we possibly can.

Summary

Forests are currently storing considerable carbon in the U.S. and are currently offsetting approximately 10% of the nation's carbon dioxide emissions. Forest systems can be managed in a wide range of manners to sustain and perhaps even increase their ability to remove carbon from the atmosphere. Some of the actions being proposed will definitely not store more carbon in forests, but there are many that will. To assure that forest projects in fact remove atmospheric carbon, it is essential that the actions conform to rigorous scientific principles, that increases of stores be monitored and verified. Forest systems can be a good share of the nation's solution to decreasing the accumulation of carbon dioxide in the atmosphere, but they cannot be used alone. It is highly likely that unless other steps are taken that the positive role that forest could play will become diminished and even switch to a negative one. We must also make sure that actions taken to increase the role of forest as carbon stores does not create other problems in terms of what we expect forests to do for us.

Mr. GRIJALVA. Thank you. Dr. Dominick DellaSala, Chief Scientist and Executive Director of Programs, National Center for Conservation Science and Policy. Welcome, and your testimony, please.

STATEMENT OF DOMINICK A. DELLASALA, Ph.D., CHIEF SCIENTIST AND EXECUTIVE DIRECTOR OF PROGRAMS, NATIONAL CENTER FOR CONSERVATION SCIENCE AND POLICY, ASHLAND, OREGON

Mr. DELLASALA. Thank you, Mr. Chairman and Members of the Subcommittee. My name is Dominick DellaSala, and I am the chief scientist for the National Center for Conservation Science and Policy in Ashland, Oregon, and I am also the incoming President of the Society for Conservation Biology, North American Section. SCB has a global membership of over 11,000 scientists and resource managers, two-thirds of whom reside in the United States.

Throughout my testimony, I emphasize that the longer we delay action on climate change, and the more we release dangerous greenhouse gases, or GHGs, into the atmosphere, the worse the situation will become for Americans and the rest of the world.

The rapid climate change we are experiencing is the result of three factors: one, human-caused releases of several gases that contribute to the warming of the earth; two, the loss and degradation of forests and pollution-related changes to the oceans; and, three, changes in ice, precipitation, water temperature, wind, and currents caused by climate change that themselves speed up the climate change process, which is called "feedback loops."

Major shifts in these changes can be tipping points that cause chain reactions in global weather patterns and other climate change events. So, as a safety net for humanity, some of our most able scientists have called for a target of the equivalent of 350 parts per million of GHGs in the atmosphere as a midterm safe limit. We are at, currently, 387 parts per million of CO₂ and climbing at a rate of two parts per million per year.

The further away from the 350-parts-per-million limit we get, the more likely it is that climate change will trigger truly catastrophic events.

Depending on how you measure them, Federal public lands cover about 30 percent of our nation's land base. They are strongholds for essential and irreplaceable benefits, such as biodiversity, clean

water, flood control, and carbon sequestration. These benefits are severely threatened by climate change and certain management activities, but these lands also hold part of the climate change solution as well.

Now, I would like to emphasize three main points from my testimony, which also includes 14 closing recommendations and three supporting documents.

First, the Nation needs a comprehensive, national goal with early and aggressive measures to reduce GHGs and particulate emissions to reach a 350-parts-per-million equivalent target.

There are two measures that Congress can require Federal agencies to contribute to that goal.

First, this Committee should direct the Secretaries of Interior and Agriculture to report back on what authorities they already have under existing laws to reduce net GHGs and how they initially plan to use them.

Second, Congress and/or the Administration should convene a committee of scientists to determine how best to retrofit existing regulations and statutes to address cumulative causes and impacts of climate change arising from GHGs and land use.

As an example, Congress can direct Federal agencies to measure the likely impact of GHGs from actions on public lands and compare alternatives as they comply with NEPA. Alternatives can be selected to optimize carbon sequestration and/or reduce emissions. This is especially important in evaluating cumulative effects from energy resources, livestock raising, and logging on public lands in a climate change context.

Second, the primary goal of public lands should be the protection of ecosystem services, biodiversity, and optimization of carbon storage. Federal agencies should be guided by the same consistent mission in this regard and provide the core for a network of public and private lands managed for ecosystem services.

To illustrate how far away from this vision we are, if you look at the recent decision by the Bush Administration to rescind the NFMA wildlife viability regulations and the fact that BLM does not even have a requirement to protect viable populations of wildlife—also, in my region, in Western Oregon, the BLM Western Oregon Plan Revisions, or so-called “WOPR,” would increase old-growth logging by 400 percent, releasing the CO₂ equivalent of driving one million cars for 132 years while further stressing our ecosystems.

Now, to help public lands adapt to, and mitigate against, climate change, Congress should direct the agencies to retain existing stores of carbon in mature and old forests as the nation’s carbon trust; reduce existing ecosystem stresses from land management, and maintain viable populations.

My third, and final, point is that Congress should set more conservative limits on both BLM and Forest Service energy development. The BLM recently has indicated it will allow additional oil and gas development across vast areas on top of extensive areas already leased. Congress should call for a full accounting of emissions and ecosystem degradation of already developed leases to better understand and mitigate these impacts.

Now, in light of the likely impacts of additional drilling, let us not make matters worse. Congress should, therefore, impose a mor-

atorium on further lease development and require revocation of any leases that are incompatible with climate and biological security.

In closing, Mr. Chairman, as you and the Subcommittee contemplate legislation for public lands to adapt and mitigate to climate change, we urge that public lands be managed for their irreplaceable contribution to biodiversity and ecosystem services by developing a national, comprehensive plan to bring down and keep GHG emissions at safe levels; reduce our dependency on fossil fuels, while developing renewable energy sources, and ensure the continuation of a biologically diverse and robust system of national forests and BLM lands. Thank you, and I look forward to questions later.

[The prepared statement of Mr. DellaSala follows:]

Statement of Dominick A. DellaSala, Ph.D., Chief Scientist, National Center for Conservation Science & Policy, and President Elect, Society for Conservation Biology, North America Section

Chairman Grijalva and members of the Subcommittee, my name is Dominick DellaSala. I am the Chief Scientist at the National Center for Conservation Science & Policy in Ashland, Oregon (www.nccsp.org) and President Elect of the Society for Conservation Biology (SCB, www.conbio.org), North America Section. SCB has a global membership of over 11,000 scientists and resource managers; two-thirds of whom reside in the U.S.

Work by SCB scientists and my organization clearly demonstrate that the accumulation of heat-trapping greenhouse gases (GHGs) in the global atmosphere creates and exacerbates risks to biological diversity and ecosystem services (Conservation Biology 2008, Exhibit A). This dangerous interference with the Earth's climatic system imposes unmitigated and unacceptable costs on present and future generations. Thus, Congress and the Obama Administration should give this issue top priority not only for the environment but with regard to its implications for national and economic security (Pumphery 2008), human health, and quality-of-life.

Federal lands are key to mitigating climate change effects as well as providing the nation with irreplaceable biological diversity, clean water, fish and wildlife habitat, recreation, and other economic values. Federal lands often contain large blocks of intact and functional ecosystems with viable fish and wildlife populations most capable of adapting to rapid climate change in the coming decades. Therefore, in an era of increasing climate disruptions, federal lands are our best hope for conserving the ecosystem services upon which society depends. Managing for the restoration and conservation of those ecological systems must become the clear and primary goal of federal agencies. To ensure this goal is met, both the Forest Service and Bureau of Land Management (BLM) must have the same mission so there is continuity of management across all 457 million acres of publicly owned lands.

In my testimony, I offer four main points and fourteen closing recommendations on what Congress and the Obama Administration can do to combat climate change on federal lands. While the focus of today's hearing is on federal lands, federal lands should not be used as an offset for unsustainable practices on nonfederal lands. We also need to take steps to reduce the impacts that activities on nonfederal lands have on ecosystems and greenhouse gas (GHGs) emissions.

MAIN POINTS

(1) The nation needs a goal with early and aggressive efforts to reduce GHG and related particulate emissions to reach an atmospheric concentration of 350 parts per million (ppm) CO₂ equivalent target and a national implementation plan that addresses all major sources of such emissions by requiring contributions from every federal agency.

(2) Congress should provide clear direction to the Forest Service and the BLM to adopt new approaches that optimize carbon capture and storage and minimize GHG emissions from land management activities, including energy extraction, on public lands.

(3) Federal agencies should adapt natural resource management to the changes brought on by climate change by adopting a 3-Rs approach—Reduce existing stressors to ecosystems and increase Resilience and Resistance of species and ecosystems to climate change.

(4) Federal agencies need clear direction to prioritize the preservation and restoration of ecological integrity of public lands so that these lands will continue to provide Americans with biological diversity and other sustainable ecosystem services such as abundant clean water, carbon sequestration and storage, air filtration, flood control, and recreation.

Each of these main points implies fundamental shifts in how the agencies are currently doing business. If we do not take these steps, the forests, rivers, and coastal zones we Americans cherish will experience unprecedented losses of biological diversity, ecosystem services and productivity, and recreational values.

I. The nation needs a goal with early and aggressive efforts to reduce GHG and related particulate emissions to reach an atmospheric concentration of 350 (ppm) CO₂ equivalent target and a national implementation plan that addresses all major sources of such emissions by requiring contributions from every federal agency.

Just months after the release of the IPCC report of 2007, this Committee heard from Tony Westerling that climate change appeared to be making western fires more severe than most had expected (Westerling et al. 2006). Geophysicists, climatologists, and other experts, including NASA's James Hansen and others (Hansen et al. 2008) announced findings that the pace of climate change and its impacts had accelerated faster than projected by the IPCC, recommending CO₂ levels in the atmosphere be reduced from the current 387 to 350 ppm through reduced GHG and soot emissions, reforestation, and agricultural reforms. To reiterate, "if the present offshoot of this target is not brief, there is the possibility of irreversible catastrophic effects" (Hansen et al. 2008).

Without a national goal for reducing GHG emissions and an accompanying implementation plan, our nation will find it most difficult to successfully address the threat of climate change. It is not sufficient to simply urge or require federal agencies to act. We must give them a clear direction for action—a goal, a process, target, and a plan. A national implementation plan would provide benchmarks against which land use plans and federal actions can be evaluated in addition to those in existing law. For example, drilling to extract natural gas increases GHG emissions but may produce lower emissions compared to other energy sources if it is part of a comprehensive national plan that selects alternatives with low emissions (Exhibit B) or combinations of demand and supply measures that result in the lowest practicable emissions and least ecologically disruptive impacts. In the absence of such a plan, it is more difficult to fully evaluate GHG emissions of federal actions and to require appropriate choices. Thus, Congress should redirect the Forest Service and the BLM to adopt and then coordinate and implement a comprehensive plan along with the traditional implementation planning already part of all federal actions and land-use planning.

We need a national strategy for federal lands that is science-driven, adaptive in its approach, and comprehensive in jointly addressing mitigation (i.e., reducing GHG emissions and increasing sequestration) and preparation (i.e., reducing the vulnerability of people and ecosystems to the impacts of climate change) alongside ecosystem services and biodiversity goals. As a first step, this Committee could request that the Secretaries of Interior and Agriculture report back on what authorities they already have under existing laws and regulations to respond to climate change and how they plan to use them. In most cases, agencies do not need new authorities to take action. However, they may need congressional oversight to ensure they explicitly consider the extent to which their actions drive climate change and the consequences of climate change for the cost and efficacy of their plans and projects. This is a matter of good governance and fulfilling existing mandates and authorities that set performance goals for agencies, including but not limited to the National Environmental Policy Act (NEPA), Clean Water Act, Endangered Species Act, Federal Land Policy and Management Act (FLPMA), and Clean Air Act. Agencies must ensure that their plans and programs will be successful under currently foreseeable climatic conditions (i.e., conditions that are more likely to be fundamentally different from the last century).

Further, to examine the efficacy of current regulations and laws, Congress should convene a Committee of Scientists to build on prior efforts used to examine promulgating regulations on national forests (COS 1999). A science committee should be tasked with determining how best to comply with existing regulations and statutes such as NEPA, the National Forest Management Act (NFMA), and the FLPMA in the context of cumulative impacts from climate change and land use.

II. Congress should provide clear direction to the Forest Service and the BLM to adopt new approaches that optimize carbon capture and storage and minimize GHG emissions from land management activities, including energy extraction, on public lands.

The current concentration and rate of increase of carbon dioxide (CO₂) in the atmosphere exceed those of the last 420,000 years (IPCC 2007). This along with emissions of several other powerful GHGs has resulted in a global average temperature increase of 0.78 C (1.38 F) over the last century. During the past several decades, we have recorded increases not only in temperature but in the number and magnitude of extreme storms, floods, and regional droughts (IPCC 2007). Such effects already are being felt throughout the nation (e.g., Exhibit A), yet they are expected to quickly become more severe in the coming decades depending on ongoing GHG emissions and land-use practices. What we do next in response to this pending crisis will determine whether climate change impacts are merely severe or truly catastrophic.

In particular, forests both are affected by climate change and can be an integral part of the solution. Very simply, forests absorb CO₂ from the atmosphere and store the carbon from it in cellulose (wood) and soil. In this process, they convert CO₂ into oxygen that makes life possible. When forests are logged, they release the majority of this stored carbon, which then contributes to the greenhouse effect.

Our nation's forests absorb the equivalent of about 10% of our carbon emissions from fossil fuels (Smith and Heath 2007, Depro 2007). Many studies have shown that old-growth forests accumulate carbon for centuries and that these forests are not neutral holders of carbon but continue to sequester large amounts of it even as they age from 300 to 800 years (Luyssaert et al. 2008). Studies also have shown that when old trees are cut down and replaced by younger ones there is a net reduction in carbon stores (Law et al. 2004, Depro et al. 2007). Much of this stored carbon is released to the atmosphere through loss of carbon in soils, decomposition and burning of slash left on site by loggers, and shipping and processing of wood products (Harmon et al. 1990, 2001). The relatively short shelf life of most wood products exacerbates these losses. The losses are neither trivial nor compensated by fast growing, young trees; it could take hundreds of years until the new forests store as much carbon as did the original old forest (Harmon 2001). Losses of stored carbon are particularly severe on industrial forest lands where timber harvest rotations are much shorter (40-100 years) than it takes for carbon stored in the original old forest to be replenished (Harmon 2001, Luyssaert et al. 2008).

One analysis found that a hypothetical "no timber harvest" scenario on public lands would result in an annual increase of 17-29 million metric tonnes (MMTC) of carbon captured or sequestered per year between 2010 and 2050—as much as a 43% increase over current sequestration levels on public lands (Depro et al. 2007). In contrast, moving to a more intense harvesting policy (similar to those of the 1980s) would result in annual carbon releases per year of 27-35 MMTC between 2010 and 2050 that otherwise would have been sequestered by no harvest (Depro et al. 2007). These losses would represent a substantial decline (50-80%) in anticipated carbon sequestration associated with existing timber harvest policies.

In Oregon, coastal old-growth forests store more carbon per acre than any other forest on Earth (Smithwick et al. 2002) and they are rich in unique fish and wildlife species. However, the BLM has finalized plans to increase logging of old forests in western Oregon (Western Oregon Plan Revisions, WOPR) by more than 400% in the coming decade, largely through clearcutting. According to BLM's own analysis, in comparison to letting these old forests grow, logging would release approximately 180 million tons of carbon that is currently stored in these forests. This is equivalent to driving 1 million cars for a period of 132 years. The WOPR, in particular, is tantamount to liquidating one of our nation's most significant carbon stores while putting the viability of several endangered species at risk and compromising ecosystem services like clean water and air. New statutory direction is needed for BLM to optimize carbon storage and fish and wildlife habitat.

In general, changing forestry and other land management practices on federal land represents one of the most powerful, and, quite frankly, least costly tools that the nation has in fighting climate change. Increasing carbon storage on and decreasing GHG emissions from federal lands is feasible across extensive areas and can be effectively implemented. To combat climate change on public lands, a fundamental shift from current forestry practices is needed that: (1) retains existing stores of carbon in mature and old forests as "carbon banks" and (2) allows or helps plantations and other intensively managed public forests optimize carbon stores by regrowing to older conditions (Harmon 2001). The Committee also should direct federal agency divisions that influence state, private, and international forestry and agriculture to

present cooperative and incentive-based plans to address climate change as federal lands should not be used as an offset for unsustainable practices elsewhere.

III. Federal agencies should adapt natural resource management to the changes brought on by climate change by adopting a 3-Rs approach—Reduce existing stressors to ecosystems and increase Resilience and Resistance of species and ecosystems to climate change.

Reducing ecosystem stressors is the single most important change in management direction to prepare forest ecosystems for the unavoidable impacts of climate change (SCB 2008). Forests, grasslands, watersheds and other ecosystems are under increased pressure from all the needs and demands we place on them. When ecosystems are stressed, they are less capable of adapting. Stressors of ecosystems include fragmentation by roads and logging, spread of non-native invasive species by management activities (e.g., roads and livestock grazing facilitate expansion of certain weeds), unusually severe fires, high water loss (through evapotranspiration) from overstocked stands (Moore et al. 2004) and water loss from stream diversions, and fossil fuel development. Domestic livestock and its associated commodity distribution chain contribute about 18% of GHG emissions (largely methane) globally (FAO 2006) and 8% nationally (EPA 2008). Notably, methane traps 20 times more heat than CO₂ (EPA 2008). A particularly effective way to reduce livestock grazing contributions to increased GHGs as well as minimize detrimental effects on biological diversity and watershed function is to provide for the voluntary retirement of federal grazing permits. An example of this is proposed in legislation before the House pertaining to the Cascade-Siskiyou National Monument and establishment of the Owyhee Wilderness (S.22).

In contrast to degraded lands, roadless areas, mature and old-growth forests, native prairie, and protected riparian areas, have many built-in mechanisms to allow them to withstand (Resistance) and rebound from (Resilience) natural disturbances. Such areas also will be more likely to resist or be resilient to climate change (Paine et al. 1998). Congress could do two things to guide agencies in this regard: (1) direct federal agencies to protect roadless areas and watersheds with low road densities; and (2) provide direction on restoration projects aimed at building resistance and resilience through decommissioning of failing roads, thinning of young trees in previously managed and overstocked forests, and restoring stream morphology and function in watersheds heavily degraded by logging, livestock grazing, and other land uses.

I would like to flag two issues: (1) the importance of roadless areas in climate change preparation, and (2) the limitations and benefits of thinning. Numerous studies demonstrate the importance of roadless areas to biological diversity (Stritholt and DellaSala 2001), drinking water (USFS 2000), and rural economies (USFS 2000). Roadless areas will become increasingly vital particularly in dry regions that depend on montane snow pack and as a connected landscape best capable of enabling fish and wildlife to migrate as the climate shifts.

As to thinning, millions of acres of old forests in the Pacific Northwest have been replaced with plantations that provide poor quality wildlife habitat (west of the Cascade Range, USGS 2002) or are now fire hazards (dry provinces, Odion et al. 2004). Treating these dense monocultures through variable-density thinning (with stops and gaps in thinning of trees to create structural diversity) is likely to help facilitate onset of older forest characteristics (USGS 2002), particularly if there is no net increase in the density of roads and soil damage is minimized. Thinning of small trees may reduce drought stress and fuel loads in dry forests (Brown et al. 2004), and lower fire risks where the number or severity of fires is expected to increase due to climate change (Westerling et al. 2006). However, there are tradeoffs. Fuel reduction methods typically release stored carbon from decomposition of slash left on site, burning of slash piles, transport and processing of biomass, and short shelf life of most wood products (Harmon 2001). The carbon released typically exceeds that of even the most severe fires as fires are relatively localized events compared to the extensive thinning efforts required to influence fire hazard. Thus, more carbon is removed by landscape-scale thinning than released by fires (Mitchell et al. in press). Also, most of the carbon in a burned forest remains on site, is stored for long periods as charcoal deposits, and only slowly decomposes over decades.

That is not to say we should not thin forests as part of restoration planning, but that we should not expect thinning to increase forest carbon stores. Interest of federal agencies in thinning forests is increasing, but thinning of forests should target areas where it is most needed (e.g., wildland-urban interface and overly dense young stands), while reducing ecosystem stressors by protecting large trees, soils, and riparian areas and by restoring stream hydrology that has been altered by high road densities. Agencies should use the best science in determining where to apply

thinning to any given location such that this action does not undermine either climate security or ecosystem health and that its application will comply with applicable laws.

IV. Federal agencies need clear direction to prioritize the preservation and restoration of ecological integrity of public lands so that these lands will continue to provide Americans with biological diversity and other sustainable ecosystem services such as abundant clean water, carbon sequestration and storage, air filtration, flood control, and recreation.

We are grateful for Chairman Grijalva's leadership in protecting large blocks of intact BLM lands through the National Landscape Conservation System. Intact ecosystems provide myriad ecosystem services, including flood control, water storage, carbon sequestration, and nutrient cycling (<http://www.millenniumassessment.org/en/synthesis.aspx>). The more ecosystems are stressed by climate change and land management activities, the more these services will be compromised. In Oregon, my organization together with the University of Oregon Climate Leadership Initiative is in the process of completing pilot projects in four river basins—Klamath, Rogue, Umatilla, and Upper Willamette (Exhibit A). In each of these basins, we are applying climate change models (IPCC 2007) and cutting edge, vegetation-climate projection models developed by the USFS Pacific Northwest Research Station MAPPS Team. Our approach may serve as a model for federal lands planning. The results of these studies indicate that striking changes to forests and rivers could occur in less than three decades. Anticipated changes include drought stress, snowpack declines of 90-95% (by 2100), greater rain-on-snow events leading to spring flooding, rapid snow melt leading to earlier onset of summertime low stream flows and warmer water, and shifts in the vegetation composition. An increase in the amount of vegetation consumed by wildfire also is probable. Such changes also could trigger the demise of threatened cold-water fish populations causing a cascade of negative ecosystem effects.

National Forests and BLM lands, in general, play an integral role in maintaining ecosystem services whether in Oregon or throughout the nation. In particular, federal agencies have numerous regulations and laws that govern the use of ecosystem services, most notably multiple use and sustained yield principles. However, in practice ecosystem services are often pitted against one another (e.g., water and carbon storage vs. timber production). For instance, intact watersheds, mature and old-growth forests, and roadless areas act as biological reservoirs, gradually storing water and slowly releasing it over dry summer months (Moore et al. 2004). High levels of logging and road building in a watershed can lead to rapid runoff, diminished hydrological functions, and losses of water storage capacity that will only exacerbate water shortages particularly in regions dependent on snow pack. As snowpack is expected to decline markedly in the coming decades (Mote et al. 2005), protecting and restoring intact areas should be a priority of federal land use planning as such lands are critical to mitigating water losses and maintaining the full range of ecosystem services.

Landscape connectivity is another critical issue that must be actively addressed to help fish and wildlife adapt to the many effects of climate change. The Forest Service and BLM need direction to undertake an aggressive program of road decommissioning to reduce the number of roads that have a high likelihood of failure, especially given anticipated increases in the number and magnitude of storms. Not only will failed roads pose a risk to human safety and reduce the quantity and quality of water, but taxpayers will pay far more to repair damages than to prevent damages. We urge the agencies to spend at least 60% of new stimulus funds on road decommissioning.

Failure to take action on climate change can have significant economic impacts (see Exhibit A). For instance, according to recent economic studies conducted in western states, if GHG emissions are not reduced, states like Oregon will face some \$3.3 billion in annual costs in the coming decades due to climate change impacts (<http://uonews.uoregon.edu/files/pmr/uploads/OR-Fnl—Rpt.pdf>). This loss represents an individual cost of about 4 percent of annual household income by 2020. Total annual costs would more than triple by 2080 if insufficient action is taken to reduce emissions. Researchers projected an increase in the number and severity of seasonal droughts and floods, higher air-conditioning costs to cope with higher temperatures, higher incidence of climate-associated health problems and deaths, and more wildfires. Similar losses are anticipated for New Mexico (<http://uonews.uoregon.edu/files/pmr/uploads/NM-Fnl—Rpt.pdf>) and Washington (<http://uonews.uoregon.edu/files/pmr/uploads/WA-Fnl—Rpt.pdf>). Federal lands can help mitigate these losses if these lands are managed with sequestration, biodiversity, and ecosystem services (especially water) as a priority.

CLOSING RECOMMENDATIONS

Climate change represents the most serious threat to our natural resources and is a growing threat to the nation's security and economy. To implement the four main actions, I have provided fourteen supporting recommendations that should be considered in new legislation or administrative policies (as amended from SCB 2008):

GHG Emissions On Federal Lands:

(1) *Require full assessment, disclosure, and mitigation of the contributions of federal actions to the drivers of climate change (GHG emissions) and full consideration of how climate change will impact the cost and efficacy of planned management actions*—this should be required of all federal actions and should include comprehensive cost-benefit and GHG emission analyses of developing domestic energy sources on public lands so that the impacts of additional emissions are fully mitigated in NEPA. As an example, Congress can direct federal agencies to treat CO₂ and methane as a metric in NEPA.

(2) *Provide clear guidance to BLM and Forest Service on fossil fuel leasing, including a moratorium on new leases pending full mitigation of GHG emissions and watershed impacts*—leases for oil and gas development, in particular on BLM lands, have been handed out in record numbers in the last few years with little concern for environmental or atmospheric impacts (Exhibit C). Even though oil and gas development on federal lands has been rampant, most of these leases have not yet been developed. Their future development will hamper any attempts to meet the 350 ppm safety net, in addition to decreasing the resilience of fish and wildlife populations and ecosystem services to climate change. Once new oil and gas wells and their associated pads and roads are developed, their emissions and habitat impacts will continue for decades to centuries. As the agency is indicating it will allow additional oil and gas leasing across large areas (http://www.blm.gov/pgdata/etc/medialib/blm/nm/programs/0/og_sale_notices_and/2008.Par.48580.File.dat/April162008_SaleNotice.pdf), on top of the extensive areas already leased, a full accounting of emissions and ecosystem degradation from already developed leases will allow agencies to implement mitigation and sequestration strategies. For undeveloped leases, Congress should require revocation of leases as developing these leases would increase GHG emissions.

(3) *The Forest Service should be given control to subsurface mineral development on the national forest system*—the Forest Service has yet to develop land-use plans for dealing with subsurface mining. While there is growing interest in developing domestic energy sources, the more we depend on fossil fuels, the more we will exceed the recommended 350 ppm safety net and create even greater risks to the nation. Federal agencies should shift production increasingly toward renewable energy sources. Areas already developed and degraded for oil and gas could make ideal sites for solar, wind, or other renewable energy projects.

(4) *Require agencies to analyze both costs and benefits, including GHG emissions, of all types of energy, biofuels, agriculture and forestry*—guidance is needed for agencies to assess a full range of alternatives before approving any federal action that would lead to a net increase in GHG emissions and that all net increases in GHG emissions should be offset elsewhere by increases in sequestration.

Biodiversity and Ecosystem Services:

(5) *Prioritize preservation and restoration of biological diversity and other ecosystem services*—on federal lands, priority ecosystem services largely include capture and storage of carbon, clean water, flood and drought abatement, biodiversity, and nutrient cycling. High priority actions include protecting roadless areas and undeveloped watersheds and reducing existing stressors by restoring degraded lands.

(6) *Require that agencies conduct assessments of ecosystem services and biodiversity potential of all ecosystems in the context of climate change*—this is essential in order to manage ecosystems for resistance and resilience to climate change.

(7) *Require the Secretaries of Interior and Agriculture to develop a connected system of lands and waters as a climate change refuge*—this system should be managed primarily for conservation of biological diversity, ecosystem services, and carbon sequestration while allowing for dispersal of native species. Protected areas are essential for maintaining viable fish and wildlife populations and high levels of genetic and species diversity, which would then be available to recolonize areas degraded by poor management or climate change. Roadless areas, riparian areas, old forests, and intact ecosystems are keys to this system.

(8) *Institute a regulatory requirement to conduct analyses of landscape connectivity when large-scale energy developments, particularly placement of energy corridors, are*

proposed for public lands—this is needed to minimize fragmentation of fish and wildlife habitat.

Existing Laws and Regulations:

(9) Congress should work with the Obama Administration to override the Bush Administration's 2008 regulations regarding NFMA and reinstate the 1982 regulations pursuant to further review by a Committee of Scientists appointed by Congress or the Administration—the regulations should be rendered compliant with climate change response, fish and wildlife viability, and findings of previous science committees (COS 1999).

(10) Reevaluate and amend BLM's sustained yield and the Forest Service's multiple use mandates to be consistent with preserving biological diversity and ecosystem services in response to climate change—land-use planning should explicitly be designed to achieve management goals under plausible future conditions with a clear objective of reducing existing stressors.

(11) Require federal agencies to modify all land-use plans to be compliant with NEPA and other environmental statutes in the context of climate change—this includes assessing cumulative effects of land-use practices (existing stressors) and climate change within the context of both mitigation and preparation.

Adaptive Management, Dedicated Funding, and Multi-jurisdictional Coordination:

(12) As part of adaptive management, apply climate change and land-use models to address potential impacts of climate change and existing stressors—this includes modeling effects on vegetation, hydrology, snow pack, fish and wildlife, fire, and forest productivity with a temporal extent of decades to a century (e.g., Exhibit A).

(13) Direct federal agencies to cooperate and coordinate federal management plans across jurisdictions and provide incentives for technology transfer and climate preparation and sequestration on nonfederal lands—significant outreach to private landowners, including timber companies and ranchers, will be needed to implement the 3-R's strategy and the 350 ppm GHG target across broader planning scales.

(14) Provide dedicated funding to develop and implement climate change strategies on federal lands—this includes increasing the number of scientists on the staff of agencies and supporting a National Science Center for Wildlife Adaptation (e.g., one such funding system was proposed in the previous Congress in S.2191, "America's Climate Security Act").

Congressman Grijalva as you and the Subcommittee contemplate legislation for public lands, we urge that public lands be managed for their irreplaceable contribution to biodiversity and ecosystem services by developing a national comprehensive plan to bring down and keep GHG emissions at safe levels, reduce our dependency on fossil fuels while developing renewable energy sources, and ensure the continuation of a biologically diverse and robust system of public lands. Thank you Mr. Chairman. That concludes my testimony.

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Mr. GRIJALVA. Thank you. Let me now ask Dr. Jack Williams, Senior Scientist, Trout Unlimited. Sir?

**STATEMENT OF JACK WILLIAMS, Ph.D., SENIOR SCIENTIST,
TROUT UNLIMITED, MEDFORD, OREGON**

Mr. WILLIAMS. Thank you, Mr. Chairman and Members of the Subcommittee. My name is Jack Williams, and I appreciate the opportunity to appear before you today to provide my views, as senior scientist for Trout Unlimited, on the role of Federal lands in combating climate change.

I have held research and management positions in both the BLM and Forest Service, so this issue is very close to my heart.

Trout Unlimited, as you may know, is the nation's largest, cold-water fisheries conservation group dedicated to the protection and restoration of trout and salmon and their watersheds.

In my testimony today, I would like to focus on three main areas: first, a brief description of how climate change is likely to impact

national forests and public lands and how these impacts are already being felt; second, I would like to describe the resources, both natural resources and people in nearby communities that are being affected by climate changes; and, third, briefly describe how the problems can be solved; that is, if we act now and utilize the best available science.

If we fail to act, the costs can be considerable, and our national forests and public lands may be irreparably harmed.

I think most of you are familiar with the likely impacts of climate change on national forests and public lands. The impacts will be severe and include things like a general warming trend, increased evaporation, drying of forests and grasslands, increased wildfire intensity and frequency, reduced snowpack, more winter precipitation falling as rain rather than snow, earlier peak flows in rivers, less consistent streamflows, more pronounced storm events, including winter flooding, and more prolonged drought.

Already, from a fisheries perspective, we see a lot of these changes, in terms of changes to stream hydrographs, earlier streamflows, and even earlier emergence of aquatic insects and changing fish migrations.

What resources and user groups are going to be impacted? Well, a whole broad spectrum, not just fisheries and wildlife and overall biodiversity, but outdoor recreation opportunities; drinking water supplies, both quantity and quality; livestock raising; timber harvest; other resource extraction; and, indeed, the safety and economic well-being of nearby communities.

It is important to realize that we cannot prevent these climate-driven disturbances to our national forests and public lands, but it is equally important to realize that we can moderate the impacts of these changes and reduce the stress to our natural resources and adjacent human communities.

Let me focus, for just a minute, on three specific problems that our public lands will face and what we can do about them.

The first is water resources and water quantity. Well, basically, to help protect water supplies and maintain streamflows, we need to essentially do the following things. We need to protect the high-elevation, wet meadows, the wetlands, the riparian areas, and the riverine floodplains.

Why? Because these are the areas that are sort of the natural sponges in our watersheds that slow the water and release it into the groundwater, so they are also our groundwater recharge zones, which are critical, from a water supply standpoint. So the proper function condition of those habitats will be increasingly important as snowpack diminishes.

Water quality. To protect water quality, we need adequately sized streamside riparian zones and adopt management standards that emphasize aquatic system protection. These stream zones should be large enough to provide shade to streams but also buffer upslope erosion and management.

In terms of increasing floods, we need to help guard against flood damage by reconnecting rivers to floodplains, again, focusing on those riparian and floodplain areas because those are the areas where floodwaters can move into, dissipate their energy, and also, again, recharge those groundwater systems.

In general, the agency should strive to improve the overall health of the land, seeking to restore conditions that allow the land to help withstand and recover from anticipated climate-change-drive disturbances.

How can we deal with the uncertainty of climate change? A solid monitoring and adaptive management program will be vital.

Our ability to adapt is limited by two things: first, our ability to detect change; and, second, our capacity to understand its consequences. The Forest Service and BLM monitoring programs are not adequate for these tasks. To address that shortcoming, the Federal government needs a new science initiative, among USGS, the Forest Service, other Federal agencies, academic institutions, and others, to help design a program to really help interpret the results of an integrated monitoring program across multiple jurisdictions.

So, in conclusion, I would say that the actions described in my testimony have a considerable price, but they also have broad benefits, not only to maintaining biological diversity but to sustaining the ecological services critical to meeting the needs of recreationists, ranchers, other user groups, and ensure the well-being of nearby communities.

In the end, we must ask ourselves, what is the cost of inaction? What will it cost to repair damage to our national forests and public lands?

I would argue that it is less costly and more beneficial to address these concerns in the near term than to wait until increased climate-driven disasters befall our lands. Thank you.

[The prepared statement of Mr. Williams follows:]

Statement of Dr. Jack E. Williams, Senior Scientist, Trout Unlimited

Chairman Grijalva and members of the Subcommittee, I appreciate the opportunity to appear before you today to provide my views as Senior Scientist for Trout Unlimited on "The Role of Federal Lands in Combating Climate Change." Federal lands provide habitat for fish and wildlife species that are of substantial economic, ecological, and spiritual value, and these lands can play a key role in preparing for the impacts of climate change. I appreciate your concern in addressing this issue in a timely manner.

Trout Unlimited (TU) is the nation's largest coldwater fisheries conservation group dedicated to the protection and restoration of our nation's trout and salmon resources and the watersheds that sustain them. TU has more than 150,000 members in 400 chapters across the United States. Our members generally are trout and salmon anglers who give back to the waters they love by contributing substantial amounts of their personal time and resources to fisheries habitat protection and restoration. The average TU chapter donates 1,000 hours of volunteer time on an annual basis.

My name is Jack Williams and I serve as Senior Scientist for Trout Unlimited. Prior to working for TU, I was privileged to serve in a number of research and management positions in the federal government, including Endangered Species Specialist for the U.S. Fish and Wildlife Service, National Fisheries Program Manager for the Bureau of Land Management (BLM), Science Advisor to the Director of the BLM, Deputy Forest Supervisor on the Boise National Forest, and Forest Supervisor on the Rogue River and Siskiyou National Forests. I also have served as a Professor at Southern Oregon University and retain the title of Adjunct Professor at that institution.

In my testimony today, I would like to focus on three major points.

First, I will briefly describe how climate change is likely to impact our National Forests and public lands. These impacts already are being felt across the country and will become more pronounced and severe in coming years.

Second, I will describe how these impacts are likely to affect natural resources and the people and nearby communities that use these resources. It is important

to recognize that a broad spectrum of user groups will be impacted and that the risks are not just restricted to fish, wildlife, rivers, and forests.

Third, I will describe how these problems can be solved—if we act now and utilize the best available science. I will provide specific examples of what needs to be done and how to do it. If we fail to act, costs will be considerable and our National Forests and public lands will be irreparably harmed.

At the end of this document, I will provide a short annotated list of recent science articles in support of my testimony.

Impacts of Climate Change on National Forests and Public Lands

Climate change is likely to alter weather patterns and storm events across the United States dramatically with significant negative consequences for National Forests and public lands. A general warming pattern will result in increased evaporation rates and drying of forest and grassland vegetation. These effects will increase wildfire intensity and frequency, especially at mid-elevations. In turn, these changes will spark surges in forest pest species and invasive weeds, triggering a cascade of further alterations in natural ecosystems.

River flows and hydrologic regimes also will be altered, with consequences not only to fisheries but also to water supplies in general. More winter precipitation will fall in the form of rain than snow, especially at lower and mid-elevations. This will reduce snowpack and increase the probability of rain-on-snow events, likely resulting in increased winter flooding. With more rain during winter and reduced snowpack, peak stream flows will occur earlier in the spring and low or base flows during summer and autumn will be reduced. Stream flows will be less consistent from year to year.

Overall, storm intensities will be greater. Floods, drought, and wildfires are all likely to increase. The increased variability and longer duration of wet cycles and dry cycles will cause considerable additional stress to natural ecosystems.

In all cases, impacts of climate change on federal lands must be viewed within the existing management context and conditions of natural systems. Watersheds, riparian systems, and streams that are in better condition will be more resistant to disturbance and more likely to rebound quickly. On the other hand, habitats that are degraded and fragmented will be less able to adapt to climate change risks. The effects of rapid climate change will be compounded with, and magnify, existing stressors. In poor-condition lands without adequate protective vegetation along streams, floods will be more severe with greater erosion and floodplain damage. If wetlands are drained or filled and watercourses are channelized, floodplains that normally slow water flow and soak up winter precipitation to help recharge groundwater aquifers, instead will speed stream discharge, encourage summer drying, and deepen droughts.

Natural Resources, User Groups, and Communities will be Substantially Impacted

Trout Unlimited and our members are especially concerned about the impacts of climate change on coldwater fishes and the habitats that support them. We also are concerned about impacts to the recreational pursuits, such as fishing, hunting, camping, and nature watching, for which National Forests and public lands are well known. However, we also realize that the impacts from climate change will be felt far more broadly.

The effects of climate change on federal lands is likely to negatively impact many natural resources, user groups, and communities, creating problems for:

- Drinking water supplies—both quantity and quality
- Fisheries
- Wildlife
- Overall biological diversity
- Outdoor recreational opportunities
- Livestock grazing, timber harvest, and other resource extraction
- The safety and economic well-being of nearby communities

In short, a very broad range of species, people, and communities will be under increasing risk unless we take immediate proactive management actions to prepare. The costs of failing to adequately plan and prepare will be high, and will be measured in substantial economic costs to fight large wildfires, deal with multi-year droughts, and repair damage from broadscale floods, and possibly in increased injury and loss of life.

It is important to realize that we cannot prevent these climate-driven disturbances to our national forests and public lands. Emissions already concentrated in the atmosphere will produce significant changes in the global climate now and throughout the next century, and ongoing emissions are likely to increase the sever-

ity of change we must endure. Recently the head of the Intergovernmental Panel on Climate Change indicated that there is little time for mitigation efforts aimed at reducing greenhouse gas emissions; the Earth has about six more years at current rates of carbon-dioxide pollution before it is locked into a future of severe global warming. We know that change already is happening, and that we will be subjected to climate change driven risks. But it equally is important to realize that we can moderate the impacts of these changes and reduce stress on our natural resources and adjacent human communities.

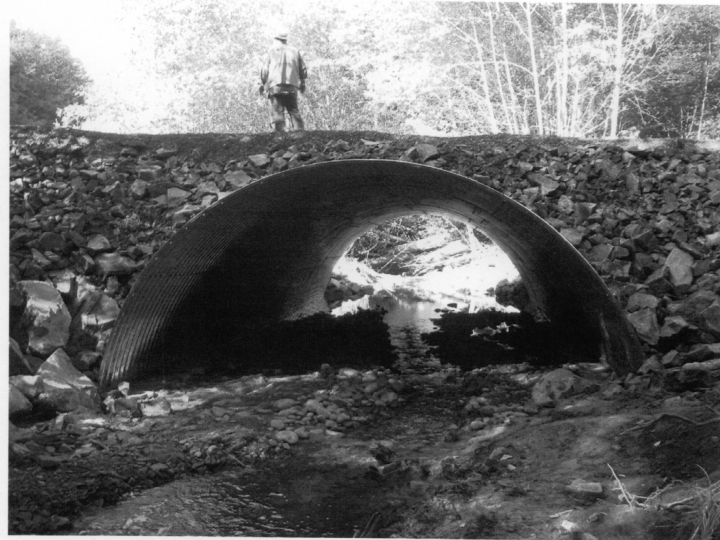
Specific Threats and Appropriate Responses

In this section of my testimony, I identify specific resources on National Forests, National Grasslands, and public lands that will be threatened by climate change and provide scientifically sound and proven strategies for resource protection.

Water resources and water quantity. To help protect water supplies and maintain stream flows, the Forest Service and BLM should restore high elevation wet meadows, wetlands, riparian areas, and floodplains. These habitats act as natural hydrologic sponges that slow water discharge and recharge groundwater aquifers, which in turn increases late-season stream flows. The proper function condition of these habitats will be increasingly important as snowpacks diminish.

Water quality. To protect water quality, agencies should designate adequately sized streamside—riparian—zones and adopt management standards that emphasize aquatic system protection. These riparian zones should be large enough not only to provide shade to streams, but also to buffer from upslope erosion and poor management activities. Agencies also should protect landslide prone areas. Inadequate protection of these areas will increase siltation and erosion, which will degrade stream systems, water supplies, and fisheries.

Increasing floods. To help guard against flood damage, agencies should reconnect rivers to their floodplains. That is, rivers should not be confined into narrow channels but rather allowed access to broader floodplains. We also should seek to restore floodplains and streamside vegetation. These measures transfer flood energies into well-vegetated floodplain zones while dissipating flows and protecting soils from erosion. In addition federal agencies should improve culverts and other stream/road crossings, and decommission poorly maintained or poorly designed roads. Inadequately sized or designed culverts and poorly maintained road/stream crossings act like time 'bombs that will plug up then blow out during intense storms causing massive landslides and debris flows. Severe flooding has substantial consequences not only to fisheries and wildlife, but also to downstream communities and recreational facilities.



Example of a re-engineered stream crossing consisting of an oversize bottomless culvert. This structure provides for free movement of stream substrates and aquatic species while also providing adequate flood capacity and roadway safety.

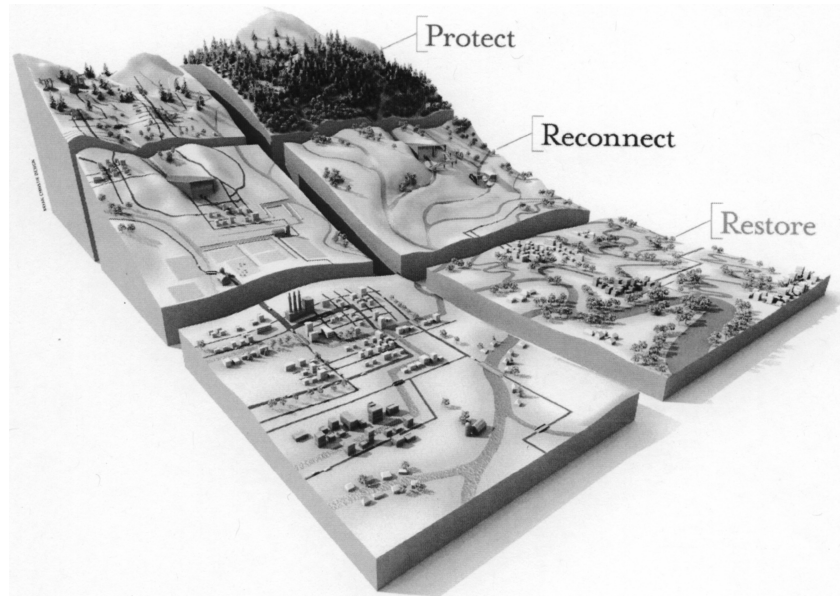
Invasive species. Weedy and invasive species are more likely to flourish in degraded habitats and to be favored during highly fluctuating environmental conditions. Some invasive species will spread more quickly during warming trends and will cause greater harm and be more expensive to control if left untreated. To better manage invasive species, we should become more aggressive in programs to detect new species invasions and in programs to control established exotic species—both terrestrial invasive weeds and aquatic non-native species.

Biodiversity loss. To deal with potential loss of plant and animal diversity, lands and waters should be managed to provide adequate habitat to support viable populations of native species. Agencies should manage to protect genetic diversity, including weak stocks and peripheral populations. High levels of genetic, life history, and ecological diversity will be necessary for species to adapt to rapid environmental change.

Increasing wildfire. Wildfires are increasing in western forests because of reduced snowpack and earlier vegetative drying during summer. To deal with more frequent and intense wildfires, agencies should selectively thin forests, primarily in wildland-urban interface zones and plantations. To prepare aquatic systems, we also should improve road networks and stream crossings, restore up- and downstream connectivity, and recover degraded riparian areas. Finally, we should adopt strong post-fire logging standards that protect soils and stream systems while providing for adequate recruitment of large wood to streams. These actions will result in less wildfire damage and decreased erosion and stream sedimentation. Riparian habitats, old growth and mature forests, and unroaded areas should be protected as well because these are the most fire resistant habitats.

Health of the land. In general, agencies should strive to improve the overall health of the land, seeking to restore conditions that allow the land to help us withstand and recover from anticipated climate change driven disturbances. This can best be done by protecting the best remaining habitats, reconnecting stream and riparian systems, and restoring degraded areas (see graphic). Watersheds that are in better condition are more able to withstand disturbances, or if disturbed, are more resilient to damage from the disturbances. Areas that may be especially important to protect include roadless areas, unroaded lands, habitat currently acting as native population strongholds, and areas of watersheds that produce high quality supplies of cold water. It is important to reconnect stream systems by removing barriers to fish movements. These barriers may include small dams whose water diversion service can be replaced by pumps or other means, inadequate or poorly-designed road culverts that create conditions that fish cannot navigate, or dewatered stream segments created by direct water diversion or by land management practices that cause the stream to go subsurface (e.g., overgrazing). Overall, it is important to reduce existing stressors, such as dense road networks or too intense or inappropriately timed livestock use. These existing stressors are within our ability to influence, whereas the added stress of climate change is beyond our ability to eliminate from the next 50 to 100 years, no matter how successful global mitigation efforts prove to be.

How might this be implemented? For the past four years, BLM, TU, National Fish and Wildlife Foundation and other partners have been reconnecting and restoring habitat for Lahontan cutthroat trout in the Maggie Creek drainage in northern Nevada. Reconnection work consisted of replacing three major culverts that blocked fish passage and removing one irrigation structure that also blocked fish movement. Livestock grazing was improved by exclusion fencing along sensitive riparian areas. Restoration efforts focused on 1,982 acres of riparian habitat, which included replanting native species and irrigation improvements. In all, 82 stream miles of Maggie Creek and its tributaries were reconnected and restored. Total cost was approximately \$600,000 during this four year period. These efforts not only benefited the threatened trout but also improved conditions for livestock use and provided increased flood capacity for the road system.



This approach to improving overall land health via watershed management can be summarized by the model of Protect-Reconnect-Restore-Sustain. Healthier lands are more resistant to climate change impacts and more resilient when disturbed by floods, drought, and wildfire.

Dealing with the Uncertainty of Climate Change

Monitoring and adaptive management will be important. Although many ramifications of climate change are relatively well understood, researchers uncover new surprises almost daily regarding the pace and intensity of change. There is substantial uncertainty and rapid environmental change ahead. National Forest and public land managers need to be better prepared to identify and track these changes and better equipped to understand their consequences.

Our ability to adapt is limited by two things: our ability to detect change and our capacity to understand its consequences. Forest Service and BLM monitoring programs are not adequate for these tasks. To address this shortcoming, the federal government needs a new science initiative among USGS-Biological Resources Division, Forest Service Research, and academic and non-profit organizational scientists to help federal land managers design and interpret the results of an integrated monitoring program across multiple jurisdictions.

Conclusion

The necessary actions described herein have a considerable price, but they also have broad benefits not only to maintaining biological diversity, but to sustaining the ecological services critical to meeting the needs of recreationists, ranchers, and other user groups, and to ensuring the well-being of nearby communities. The actions I have described are very low risk steps that have a very high likelihood of substantial benefit to multiple parties. Many actions create jobs as well.

National Forests and public lands provide substantial ecological services that include clean water, clean air, and buffering from drastic flood and drought. Without adequate effort to sustain these critical ecosystem services, private property owners, local governments and the human communities they make up will be excessively burdened.

In the end it is important that we ask ourselves: What is the cost of inaction? What will it cost to repair damage to our National Forests and public lands? What will it cost in private property loss and public safety? I would argue that it is less costly and more beneficial to address these concerns in the near-term than it would be to wait until increased climate change driven disasters befall our lands and nearby communities. The time to act is now. Our National Forests, National Grasslands, and BLM public lands are national treasures that are irreplaceable in our lifetimes.

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Mr. GRIJALVA. Thank you very much.

Mr. Spiering had to leave early for a commitment. I think the hearing went longer than the time he had. I will be forwarding some questions to him. I think he made a comment about nuclear power, i.e., through uranium mining, as a nonpolluting activity.

So my question is going to be about MOAB and the 16 million tons of waste that is yet to be dealt with; the 500 abandoned mines on Navajo Country that EPA now is doing in tiers to see which is the priority they are going to begin the cleanup and closure of those abandoned mines; and the orphaned mine near the Grand Canyon that continues to be a problem and polluted the watershed there.

Those are a consequence of direct uranium mining, and I understand that nuclear power is not an absolute yes-or-no proposition

that we are dealing with, but there are consequences, and we are going to forward the questions to him about those consequences.

In addition, is there any public land, i.e., the Grand Canyon, in which uranium mining should not be allowed? I think that is an appropriate question to ask as well.

Dr. Harmon, You raised some serious concerns about the drying of the forests and the subsequent increase in wildlife frequency and intensity. Could you give us your prediction on what we will face in the upcoming fire seasons due to climate change and how land-management agencies can better be prepared to deal with that reality?

Mr. HARMON. Well, fire is really a hard thing to predict, Mr. Chairman, but it is likely, if the current trends continue, that, yes, we will have warmer, longer growing seasons—that is good for tree growth, in part. But, in the West, where we have, in the summer, a shortage of water, that may also mean a longer period of dry fuels, and so there could be larger fires. They may or may not be more severe because only in some ecosystems are fuel levels really higher than we might expect naturally.

It is hard to say what to do because it is starting to create a problem that is very, very expensive to try to solve. I think we have to concentrate our efforts on protecting housing and things where people could lose economic value and their lives. That would be one place.

Where we can restore a natural fire regime, we should try to do it because it is just cheaper. That can conflict with the first priority of protecting people, but there are areas where this could go on.

One of the things is people have the sense that there is a tremendous loss of carbon in a fire, and, as my written testimony shows, the range is about 5 percent of what is in an ecosystem to about 15 percent. It is not huge. The trees do not really burn up. If they burned up, people would not be fighting about timber salvage.

So one thing is people do not like the fires; they are very emotional about them. They are very dangerous, but they are not nearly as bad for the carbon cycle as often is portrayed.

Mr. GRIJALVA. Thank you. Dr. DellaSala, you mentioned that global warming is already affecting species and natural resources across the country.

Let me ask you, relative to the public lands, you talk about changing the mission of the Forest Service and BLM. Do you think we need to change the Organic Act or the Multiple Use Sustained Yield Act? Can we accomplish some of this within the regulatory framework, or is that a statutory issue as well?

Mr. DELLASALA. Well, thank you for that question, and, as I have indicated in my testimony, there are a number of ways that this Subcommittee could address this.

One is that you could ask the Secretaries of Interior and Agriculture whether or not they have the existing structures to respond to climate change and some of the challenges that we are now seeing.

Two is that you could request that a committee of scientists be convened that would take a look at the whole regulatory package within the context of climate change and cumulative impacts.

So those are two immediate things. There are other measures, too, that I would recommend, such as working with the Obama Administration to restore the National Forest Management Act viability clause for maintaining viable populations on Federal lands and working with Representative Kind to make sure that a similar measure is introduced for BLM lands which are not managing their wildlife for viable populations.

So there are number of different ways to look at it, but I think the challenge here is that a lot of those statutes were put together in the early part, or the midpart, of the last century, and, quite frankly, they were not up to the task of what we are seeing now, in the 21st century, with the increased stress loads that we have put on these ecosystems, in addition to the climate change impacts.

Mr. GRIJALVA. Thank you very much.

Dr. Williams, as we focus on the adaptation of our public lands to a changing climate, in your testimony, you talk about that healthier systems are more resilient to the change. What actions could land managers be focusing on today to restore and rehabilitate wetlands and watersheds?

Mr. WILLIAMS. Well, I think you always try to do as many things with the one stroke as you can.

If we know we are going to have a lot of fires on the landscape, one of the systems that we need to work on are our road systems. The national forests and BLM public lands have huge road networks, and many of these roads are essentially in a maintenance backlog.

From a fire standpoint and an aquatic systems standpoint, the culverts are undersized, the roads are poorly managed, and we need to upgrade those systems, especially in areas that are likely to fail as a result of fire and then subsequent erosion.

So the road network greatly influences the hydrologic, the stream network. The culverts and the road crossings are critical areas because these can build up with sediment and debris and kind of blow out.

So, on the one hand, the road network is a critical element to focus on.

The other part of that is really the meadow riparian habitats along streams and along meadows that are, again, these kind of natural sponge areas that both soak up the energy and soak up the water and then recharge the aquifers during rain. With reduced snowpack, more winter precipitation falling as rain rather than snow, the health and condition of those lands are going to be absolutely critical to maintain base streamflows.

Mr. GRIJALVA. Let me thank you. Your full written testimony is part of the record, and if colleagues, as I had mentioned earlier, have questions, they will submit them, and we will forward them to you for your responses in writing. Thank you very much, and thank you for the time.

Let me invite the next panel, please.

[Pause.]

Mr. GRIJALVA. Thank you very much. Let me ask our colleague, Mr. Holt, for the introduction of one of our panelists.

Mr. HOLT. Thank you, Mr. Chairman. Thanks for an important hearing that you have been undertaking today, and I thank you for inviting the next distinguished and very capable witnesses.

I would like to introduce to you, and to the Committee, Mr. Rick Ridgeway. He is a legend among climbers, a leading climber and adventurer: the first American to reach the summit of K-2; a participant in the first western mountaineering expedition to Butaan; a person who scaled the first big wall climb in Antarctica. So he has a number of climbing pelts on the wall and has, really, a well-earned reputation among explorers.

Mr. Ridgeway is also a documentary film maker and a photographer and a writer, and, in his free time, Rick Ridgeway is the Vice President of environmental programs and communications at Patagonia. He develops, implements, and promotes the second, two, of the company's three-part mission statement: to make the best product, cause no unnecessary harm, and to use business to inspire and implement solutions to the environmental crisis.

Mr. Ridgeway, I believe, your experiences give you a unique view of our environment—sometimes from above, sometimes from beside, sometimes from right in it—and a view of the need to preserve it.

So we welcome you today, and, Mr. Chairman, I, again, thank you for setting up this hearing.

Mr. GRIJALVA. Thank you, sir. Let us begin with Mr. Ridgeway, Freedom To Roam. Your testimony, sir. Thank you.

**STATEMENT OF RICK RIDGEWAY, FREEDOM TO ROAM,
VENTURA, CALIFORNIA**

Mr. RIDGEWAY. Thank you so much, Mr. Chairman, and, Mr. Holt, for the introduction, and, also for the record, the earlier introduction that Representative Capps so graciously gave to me and to our initiative, Freedom To Roam, which, while it was initiated at our company, Patagonia, is now its own independent organization, and I would suggest to the group that we are not what you might expect.

We are the only organization I know of that brings together groups from the Department of Defense and the Association of Fish and Wildlife Agencies, business leaders from Wal-Mart and Microsoft, energy providers from BP-America, hunting and angling groups, including the National Wildlife Federation; the Theodore Roosevelt Conservation Partnership; conservationists from the Defenders of Wildlife; and scientists from the Wildlife Conservation Society.

We know that the planet is warming. We have read the IPCC prediction that if nothing is done to adapt to changes that are now recognized as inevitable, we could lose 40 to 70 percent of the species on our planet, and a change, on that scale, is uncharted territory, and no one, including our best scientists, fully understands the consequences that loss would have on our own species, but those scientists do know that to adapt to these inevitable changes, most of the wildlife in our United States needs the ability to move. It needs the freedom to roam around in habitats, many of which are on public lands. But if habitats become fragmented by development or shifted by climate change, then many will not survive.

But there is solution, and it is based on best science, and it is this idea of connecting landscapes to give animals the freedom to roam, but, also, I want to stress, to give people the freedom to hunt and fish and to hike and to camp and to ranch and even to do business in ways compatible with wildlife.

Now, before we look into how we propose to achieve that, let us take a pause to look at where this idea of wildlife corridors came from.

It was established when Tom Lovejoy, an acclaimed biologist here in Washington, began long-term study in the Amazon.

Mr. LOVEJOY. [On video.] In the late 1970's my Brazilian colleagues and I—a grand experiment in landscape ecology, and we persuaded those who were clearing the forests to do it in a way that gave us a series of forest fragments of different sizes, and that enabled us, ultimately, to demonstrate how big a national park should be.

That is a big number—in the Amazon, it is about 1,000 square kilometers—so the question that also arises is, what do you do if you do not have such a size? Well, then the answer is pretty obvious, actually. You connect the fragment to other fragments to larger forests. You create, in a sense, wildlife corridors so animal species can move around.

Mr. RIDGEWAY. To illustrate the importance of connectivity and corridors as an adaptation strategy for climate change, I want to show you the story of the lynx. Now, the present-day range of the lynx looks like this, but what might happen as the planet warms?

Well, scientists, using the most advanced tools currently available, predict that the habitat of the lynx is going to shift here by 2060, and it is going to go here by 2100. Now, you can see that these marooned habitats are likely too small to sustain lynx populations. So what do you do? Well, you connect the fragments with wildlife corridors.

But it is not only predators, like the lynx, that need the freedom to roam, but it is migrating songbirds, counted by the millions by birdwatchers; it is game birds and waterfowl, valued by millions of sportsmen; it is big-game species that all of us celebrate.

Now, take the pronghorn antelope. This is the fastest big-game animal on the continent. It can run 60 miles an hour, and, every fall, one group of pronghorn leave the Teton National Park and migrate south 170 miles to their wintering grounds, where now, instead of sagebrush, they encounter hundreds of recently installed gas wells. But there are solutions, from new technology that, as we have heard earlier, allows gas wells to be clustered, 25 and more, on a single pad, and this gives the pronghorn more room to roam.

Well, it is not just gas wells, however, but pronghorn also have to crawl under fences, and, again, there is a solution in fences that are designed with a minimum clearance and a bottom wire with no barbs that allow the pronghorn to freely crawl under the fences.

So these are solutions, and solutions is what our coalition, Freedom To Roam, is about. With a steering team that includes corporations, some of them Fortune 50 companies; that includes conservation organizations known for their broad-based inclusion; and government organizations representing every state's role in providing solutions to protecting wildlife.

But what are those solutions, and what is the roadmap to protection? Well, we think and propose that it has five steps: first, to define corridors, to develop a legal definition for “corridors”; and, two, to use that legal definition to identify critical corridors across the United States; third, to give designations to corridors that qualify, beginning with the public lands; and, four, to work with private landowners to come up with tools and incentives to live and ranch in ways compatible with wild animals; and, five, to allocate funds to support science, to support projects, such as road crossings and wildlife fencing, to support private landowners.

We know this will require the cooperation of private citizens, of businesses, conservation groups, and, of course, governments, but we also believe we can do this because we are all sensing this new climate, this climate of cooperation that is driven by climate change, that we are all in this together, that we all live on the same planet, and, together, we can preserve the health of our home for ourselves and for our children and for the wildlife that is part of our American identity.

So, Chairman, thank you so much, and Members, for the invitation here to share with you this vision that Freedom To Roam has. [The prepared statement of Mr. Ridgeway follows:]

Statement of Rick Ridgeway, Director of Environmental Initiatives, Patagonia Company, for Freedom to Roam, “A Coalition to Conserve Wildlife Corridors”

Thank you for the opportunity to testify. I am Rick Ridgeway, Director of Environmental Initiatives for Patagonia Company. Patagonia and a group of business and conservation partners have recently formed Freedom to Roam. This is a new model for landscape protection: a collaborative effort among businesses and conservation organizations to bring ecological connectivity to the forefront of public attention through sound science and effective policies. Freedom to Roam’s continental vision encompasses the United States and Canada while facilitating local solutions to landscape connectivity.

We’re the only organization I know of that brings together groups such as the Association of Fish and Wildlife Agencies, business leaders from Wal-Mart and Microsoft, energy providers such as BP America and Southern California Edison, hunting and angling groups including the National Wildlife Federation and the Theodore Roosevelt Conservation Partnership, conservationists from the Association of Fish & Wildlife Agencies, Defenders of Wildlife, and Yellowstone to Yukon, and scientists from the Wildlife Conservation Society. We also are working with the Western Governors’ Association and the Department of Defense. Together this effort is galvanizing policies, practices and on-the-ground efforts designed to ensure that landscapes across the continent maintain their ecological integrity.

I am appreciative of the work of Committee Chairman Rahall and Subcommittee Chairman Grijalva and the members of this Subcommittee on your efforts to develop tangible solutions in the face of a changing climate; in particular, for seeking to define the role of federal lands to lessen the impacts of climate change through sound stewardship. I am pleased that the Committee and Subcommittee members and their staff are showing such a willingness to devote their time to address this critical issue. It indicates to me that you, too, feel that our public lands heritage is at a crucial crossroads.

The Challenge Ahead

There is no doubt that the planet is warming. The International Panel on Climate Change predicts that we could lose as many as 40-70 percent of the species on Earth if nothing is done to address the impacts of climate change. No one, including our best scientists fully understands the entire gamut of consequences this biological loss could have on us. But scientists agree that the ability to migrate across the landscape in response to this phenomenon will be key to the survival of many North American species in the coming decades. The public lands will play a critical role in allowing this migration to take place. In fact, if habitat is fragmented by development and then altered by climate change, many of our native species won’t survive.

Thus many in the scientific community agree that the most effective option we have to address climate change adaptation for biodiversity is via corridors and connectivity. (see Heller, N. and E. S. Zavaleta, 2008, Biodiversity management in the face of climate change: a synthesis of 20 years of recommendations, Biological Conservation).

Convergence of Wildlife Corridors and Habitat Connectivity as a Policy Strategy

In the past year, a steady stream of new policy documents have been developed by working groups, task forces, committees and other groups of knowledgeable specialists to assist decision makers in identifying the importance of protecting ecological connectivity. As a result, new policies for corridor protection will be central to adaptive management strategies that seek to address the impact of climate change on wildlife. In the past six months, three new policy reports were prepared and circulated by a) the 19 western states via the Western Governors' Association, b) the U.S. Forest Service, and c) the U.S. Fish and Wildlife Service. All three reports incorporated corridors in developing strategies to address climate change.

The first political acknowledgement and support of corridor conservation occurred in the West, where the 19 states are made up of a patchwork of federal, tribal, state and local governments as well as private lands. These are the members of the Western Governors' Association (WGA) who unanimously passed a Wildlife Corridors Initiative. In the Initiative's call to action the governors acknowledged "[w]estern ecosystems do more than sustain wildlife. Crucial habitats and corridors provide ecosystem services that range from enhancing water quality to creating recreational opportunities to ensuring the pollination of our crops. To a great degree, the viability of wildlife is an indicator of the functionality of ecosystems—and so contributes to the sustainability of our communities, our economies, and our general well-being." (see "WGA Wildlife Corridors Initiative Report" 2008 Western Governors' Association, Denver, CO)

The U.S. Forest Service is beginning to develop a response to climate change. In its recently completed framework on this topic, the agency spelled out several actions it can take to facilitate adaptation. This includes a category of anticipatory actions "intended to prevent serious disruptions due to changing climate." The report suggests such potential actions as "...genetic conservation of species, assisted migration of species to suitable habitat, development of wildlife corridors to facilitate migration..." (see "Forest Service Strategic Framework for Responding to Climate Change," Version 1.0, October 2008, U.S. Forest Service, Washington, DC)

The U.S. Fish and Wildlife Service (USFWS) recently completed its first draft of a strategic plan to address climate change. Although the strategy is currently only available for internal review and labeled "internal discussion draft" and has not been commented upon by external entities, it too promotes habitat connectivity to address habitat fragmentation and climate change. One of the goals in the plan is to "deliver landscape conservation that supports climate change adaptations by fish, wildlife and plant populations." One of the objectives for this goal is for the USFWS to work with partners to identify and conserve landscape-level corridors to help build connectivity within and between landscapes. This indicates that habitat connectivity at two different spatial scales is considered a key consideration for allowing plants and animals to move and adjust to changing environmental conditions. (see "Rising to the Urgent Challenges of a Changing Climate, Strategic Plan for Responding to Accelerating Climate Change in the 21st Century [Internal Discussion Draft]." U.S. Fish and Wildlife Service, December 12, 2008, Washington, DC)

At this time, there is an emerging consensus by the scientific community, federal agencies, many of the states, and leading national conservation organizations that it will be necessary to identify and protect wildlife corridors and habitat connectivity so that wildlife will be able to adapt to a warming world. Therefore, any future federal legislative efforts to address climate change will be greatly enhanced by assuring connectivity conservation.

Federal Legislative Action

The federal government plays an important role in leading the nation's efforts to identify and protect ecological connectivity as a climate change adaptation strategy. I believe that the federal government's land and water management agencies need to have the appropriate authority, direction, and funding to ensure habitat connectivity is conserved across all affected landscapes and water bodies. In addition, the federal government must work with many partners to further this goal across all jurisdictions, including state and local governments, tribes and Native Americans, as well as private land owners.

As I mentioned, the supporters of Freedom to Roam have just begun to review and collect information on policies and practices to implement this vision. The following concepts are some of the suggested methods to achieve the overall goal of improving connectivity opportunities.

As this Subcommittee and other congressional committees develop climate change legislation, it would be extremely helpful to consider the following actions be incorporated as a means of identifying and protecting wildlife corridors and habitat connectivity as an adaptive management strategy.

Create a new federal lands designation: wildlife corridor

Perhaps the boldest, most visionary piece of legislation would create a series of linked ecological networks around the country that would provide for the migration and dispersal of wildlife and other native species. Such a system would allow for a level of landscape connectivity that assures that animals and plants could adjust to shifts in habitat caused by human activity, natural environmental cycles, and global climate change. Weaving a web of habitats across the nation will secure the long-term survival and vibrancy of America's cherished natural heritage for present and future generations.

In order to ensure that wildlife and other biota can migrate and disperse safely across landscapes for their continued health and vigor, a system of connecting habitats could be congressionally designated as "national wildlife corridors." We envision these as part of a National Wildlife Corridor Conservation System.

National Parks, Wild and Scenic Rivers, Wildlife Refuges, and Wilderness areas are national systems developed to serve an important purpose to conserve our nation's natural heritage. Today, given the challenges of addressing climate change, our generation has an opportunity to develop an equally important national system that allows species to move and adapt. These "national wildlife corridors" could be administered in such a manner as to leave them unimpaired to sustain flows of wildlife and plants between different areas of a landscape or region, over time, as well as for the use and enjoyment of the American people.

Include wildlife connectivity in federal land management planning

Climate change legislation must promote the identification and protection of connectivity or migration habitat via federal land and water management agency planning. Currently, I am aware of two examples of the identification and protection of a wildlife migration corridor via federal management plans.

The Bridger-Teton National Forest in Wyoming, on the southern end of the Greater Yellowstone Ecosystem, has completed the first administrative designation of a wildlife corridor in the nation on Forest Service lands. This unprecedented action was sought to maintain secure habitat for the annual migration of a special herd of pronghorn that moves an estimated 45 miles across national forest lands, comprising approximately 29,400 acres, in its semi-annual 150-mile-long trip between their winter range in Upper Green River Basin near Pinedale, Wyoming, and their summer range in Grand Teton National Park. This is one of the longest remaining land-based wildlife migrations in North America, and it is the longest in the lower 48 United States. Archeological evidence suggests that this wildlife pathway has been used for over 6,000 years.

To protect this migration, the Bridger-Teton amended its Land and Resource Management Plan (Forest Plan) by identifying the wildlife corridor on a map and developing a management standard to ensure that no new projects or activities impede the migration corridor, known as the Path of the Pronghorn. Such an administrative designation formalized in the Forest Plan can be replicated on national forests across the country.

Part of the Path of the Pronghorn also falls on Bureau of Land Management (BLM) lands in Wyoming. In the recent revision of its Resource Management Plan, the Pinedale District in Wyoming protected a portion of the pronghorn migration on their lands by approving the designation of the Trappers Point as an Area of Critical Environmental Concern (ACEC) whose management goal is to preserve the viability of the big game migration. In future BLM planning efforts, ACEC designations to protect wildlife connectivity can be utilized as a means to maintain connectivity.

The Forest Service, BLM and all other federal land and water management agencies should be provided direction and funding in climate change legislation to identify and protect key connectivity habitat via their planning processes.

Provide wildlife connectivity across federal lands highways

The Office of Federal Lands Highways "provides program stewardship and transportation engineering services for planning, design, construction, and rehabilitation of the highways and bridges that provide access to and through federally owned

lands.” Currently, maintaining habitat connectivity across surface transportation infrastructure has not been mandated in any past or current transportation legislation. To ensure busy roads running through federal lands provide safe passage of wildlife across transportation barriers in areas important for connectivity, legislation should direct the federal land agencies to assure that there are retrofits for current infrastructure and incorporate wildlife needs into future development plans for their federal highways. This means terrestrial and aquatic movement patterns must be considered in relation to the location, design, construction and operation of infrastructure projects.

Support state wildlife corridor initiatives

The Western Governors’ Association (WGA) Wildlife Corridors Initiative is a prime example of states taking the lead in developing new policies to protect wildlife corridors in the face of a changing climate. The WGA states as well as all others will need support, cooperation and coordination from the federal government as they embark on efforts to address habitat connectivity and crucial habitats. One recommendation from the Initiative’s climate change recommendations pertinent to my testimony today is:

“Western Governors should consider supporting establishment of new revenue streams to support wildlife adaptation to climate change in any relevant climate change legislation, such as carbon cap and trade or carbon tax legislation that may be enacted by the U.S. Congress.”

Federal climate change legislation should make every effort to work with the states, as the primary authorities responsible for the management of wildlife, to support their efforts to identify and protect wildlife corridors. State efforts to develop new plans to assist fish and wildlife adaption to climate change, and to ensure that state wildlife action plans address this challenge, deserve greater federal encouragement and financial support.

Work with Native Americans and tribes

Federally-recognized Indian tribes have jurisdiction over a reservation land base of more than 52 million acres in the lower 48 states while Alaskan Native lands comprise another 45 million acres. In addition tribes control natural resources outside of reservations due to federal court decisions and voluntary cooperative agreements, which allow co-management status between tribes and states on more than 38 million acres. Climate change legislation that seeks to employ the conservation of wildlife corridors as an adaptive management strategy must work with Native American tribes to identify and protect wildlife connectivity on lands and in waters under their management authority. Congress should also explore ways to provide Native American tribes with technical and financial resources necessary to develop and implement plans to facilitate the survival of species throughout lands that the tribes directly control or affect.

Support private land conservation

Often private lands are a critical component of many corridors and therefore are crucial to maintain habitat connectivity. One such opportunity for legislation would be to develop incentives within the Land and Water Conservation Fund to target the conservation of corridors and connectivity on private lands. Another would be for climate change legislation to create incentives and financial support to encourage willing land owners to manage their properties so they are wildlife friendly and allow for the unencumbered passage of species through their property in key areas. It may also be appropriate for Congress to consider making permanent existing tax incentives that encourage land conservation and habitat protection.

Provide new streams of federal funding

Given the immense challenges to protect wildlife in the face of climate change throughout the nation, the federal government must lend a financial hand to allow federal agencies, states, tribes and private land owners to implement protections on behalf of habitat connectivity and wildlife corridors. It would be appropriate to consider devoting significant revenues generated by any future climate change legislation to this purpose. In this regard, I applaud the U.S. House of Representatives for your recent passage of the FY09 Omnibus Appropriations bill which will fund a National Global Warming and Wildlife Science Center and directs the Secretary of the Interior to coordinate with other agencies in developing a national strategy to assist the survival of wildlife and ecosystems in the face of global warming. This legislation provides an excellent beginning to develop new solutions for federal land and water management and creates momentum for future endeavors on behalf of wildlife.

Conclusion

Climate change will challenge our ability to maintain our nation's rich natural heritage. However, most agree that identifying and protecting wildlife corridors and connectivity habitat is a key adaptive management strategy worth pursuing. Freedom to Roam appreciates being part of the growing effort of local, state and national conservation organizations, and state and federal agencies, who are working to ensure the long-term survival of America's fish and wildlife. On behalf of Freedom to Roam, I thank you for the opportunity to testify and look forward to working with the Subcommittee as it develops legislation to fully achieve the protection of our nation's wildlife.

Thank you.

Mr. GRIJALVA. Thank you very much.

Next, let me ask Ms. Lynn Jungwirth, Executive Director, Watershed Research and Training Center. Welcome. I look forward to your testimony.

STATEMENT OF LYNN JUNGWIRTH, EXECUTIVE DIRECTOR, WATERSHED RESEARCH AND TRAINING CENTER, HAYFORK, CALIFORNIA

Ms. JUNGWIRTH. Thank you, Mr. Chairman. I am very happy to be here. I work with the forestry community folks around the West, and we have been working on forest restoration on public lands for many years.

I am here today to talk a little bit about Federal lands' role in combating climate change and try to respond to your challenge, at the opening, to talk about adaptation, mitigation, and key laws.

So I have my written testimony, but I am just going to try to respond to what you ask.

Mr. GRIJALVA. Thank you.

Ms. JUNGWIRTH. So, adaptation; what are we doing to try to adapt to this climate change?

I live in the Trinity Forest. It is a frequent fire forest. We are seeing rapid change. We are converting to brush fields on the southern slopes because once the forest burns, it cannot seem to regenerate itself naturally.

So what are we trying to do? We are trying to put in a series of strategic fuel breaks that would keep the fires contained so that they never gain that speed and that intensity they get as they get larger.

We are trying to work on the riparian areas because the riparian areas are the areas that are moist enough to slow down a slow-moving fire and to help you protect that.

We are trying to put fire buffers around the spotted owl habitat that we are supposed to be protecting, and the coho habitat in those forests where you have very steep mountains. When the fire denudes the land, the ground, the erosion that happens in the key coho habitat is pretty horrific, and it does not just happen for one year; it goes on and on for years.

So we are working very hard on forest restoration to try to deal with and to help the forest stay resilient in the face of climate change.

In terms of climate mitigation, the greenhouse gas mitigation, the forest fire that was in California last year; the air quality board did a little study for us, and they figure 84 million tons of greenhouse gas emissions. So that is 12 million vehicle years.

So when they put carbon trading in to try to help cap-and-trade carbon emissions, GOD is going to be having to come up with billions of dollars every year. California wants to get to a level of 427 million tons, 84 million tons in one year of wildfire. How, in the world, can you affect the manmade carbon and overcome that 20 percent?

So we have to mitigate it, and we have to slow down the carbon from those fires. When we do that, our people are putting those into wood pellets, and they are making electricity with it.

There is a little guy up in Siskiyou County who has a nursery. He made some wood pellets to burn for his nursery heat. It gives him CO₂-saturated air for his nursery. He has got better plants. He took those pellets, used pyrolysis, made some diesel. It is generating electricity. He is generating electricity on a scale that you can move through the local wires. A two-megawatt plant, two megawatts of power, you can move through the local wires. You do not need huge, new transmission lines.

So these are the people who are on the ground, who are trying to be a world-class workforce to try to restore, maintain, and protect the public lands.

So that is kind of where we are with adaptation and mitigation. In terms of the key laws, we firmly believe that the Organic Act, that NEPA, that the Multiple Use Act are so out of date as to be the impediment.

[The prepared statement of Ms. Jungwirth follows:]

**Statement of Lynn Jungwirth, Executive Director of the Watershed Center,
Executive Director, Watershed Center, Hayfork, California**

I'd like to thank the committee for the opportunity to provide testimony at this important hearing. My name is Lynn Jungwirth and I am the Executive Director of the Watershed Center, a small community forest organization in the town of Hayfork, which lies in the middle of the Trinity National Forest in California. Since 1993, my organization has worked at the nexus of healthy forests and healthy communities. I'm privileged to work with the "Rural Voices for Conservation Coalition", a group of over 40 organizations working in local community forestry activities in the west. My organization is also a member of the Nature Conservancy's "Fire Learning Network" designed to help restore fire adapted ecosystems and create fire adapted communities. My testimony will include both my experiences working in the Trinity Forest and lessons from the broader experiences of my colleagues who work in Oregon, Washington, Montana, Idaho, New Mexico and Colorado. We have worked diligently over the past 15 years to promote the hard work of restoration and stewardship of national forest lands by doing the even harder work of multi-stakeholder collaboration and partnership with the federal agencies.

First, I'd like to thank you for taking leadership in acknowledging and examining the natural resource aspects of climate change. Your federal land communities have been proactive partners in figuring out how to protect the conservation gains of the past 30 years in the face of climate uncertainty. Rural communities and landscapes need your attention in preparing for the impacts of climate change. And yet, they can also play a significant role in reducing greenhouse gas emissions. Through this testimony, I attempt to offer lessons from rural landscapes and communities regarding the role of national forests in combating climate change.

Climate change discussions in the U.S. have been framed by the approaches and agreements that came out of international negotiations of the United Nation's Framework Convention on Climate Change. These approaches have been dominated by an urban, industrial perspective that focuses on transportation, electricity generation, and large-scale manufacturing as the major sources of anthropogenic (man-caused) greenhouse gases and seeks to reduce emissions from those sources as the pivotal strategies for combating climate change. The rural, natural systems perspective is somewhat different, perhaps because rural communities and landscapes are experiencing the ecological stresses of climate change, including insect pandemics, intense wildfires, degraded fisheries, invasive species, and ecosystem conversion at

an observable rate. We don't actually need the scientists to measure the change in climate; we are living it. We see the changes on the landscapes, the issues for forest management and policy, and we are helping develop responses and solutions. However, the way we see the issues and the solutions don't neatly fit the urban-industrial intellectual construct or the existing policy mechanisms or carbon markets.

Urban citizens, of course, are experiencing the effects of climate change in their communities—through increased temperatures, urban heat islands, air conditioning bills, and air pollution—as well as through increased stresses on their urban forests, primarily insects and disease. Urban communities, however, will also experience the effects of climate change on rural landscapes through reduction of water quality and quantity, the growing taxpayers' burden of billion dollar fire suppression costs, and the social costs of poverty in public land communities. Urban citizens will soon experience the effects of climate change policy or regulation in higher costs for energy and incentives for energy efficiencies.

The United Nations Framework Convention on Climate Change and the Kyoto Protocol did not address forests for various reasons, such as the difficulty of measuring carbon flux in dynamic natural systems, the long-term benefits of forest systems (relative to immediate benefits of industrial technology change), and the political controversy over whether forests should be included in carbon offset markets. Only afforestation and reforestation were accepted in the initial Kyoto protocol, while a later negotiation following Kyoto accepted forest management improvements and most recently, avoided deforestation.

Progress on forests is being made through the protocol discussions at the international level, as well as in various regional and state protocol, such as those under the Chicago Climate Exchange and the California Climate Action Registry. But the progress is slow and the protocols are having difficulty addressing integrated forest activities, such as thinning forests to reduce wildfire risk and using the small-diameter woody by-products for community-scale bio-energy to offset fossil fuels. Nor do the protocols know how to effectively deal with the environmental and social "co-benefits" of forest activities. While these co-benefits should be seen as providing additional value to society, beyond the direct carbon benefits, they are difficult to measure.

Due to the limited experience with carbon markets and accounting, we are only beginning to learn how to do the hard work of "full life-cycle accounting." This life-cycle accounting is essential for the carbon markets to function well and critical to helping illustrate that the supply chains of many urban products come from rural economies and rural soil, forests and grasslands.

Reducing Greenhouse Gas Emissions

There are five strategies outlined in the McKinsey and Co. 2007 report "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?" They are listed with their abatement potential:

1. Increasing energy efficiencies in building and appliances—710 to 870 megatons
2. Increasing fuel efficiency in vehicles and reducing carbon intensity of transportation fuels—340 to 660 megatons
3. Pursuing various options across energy intensive portions of the industrial sector—620-770 megatons
4. Expanding and enhancing carbon sinks—440 to 590 megatons
5. Reducing the carbon intensity of electric power production—800 to 1570 megatons

We can expand and enhance carbon sinks through stewardship activities on public land. In fact, the McKinsey report offers active management of our private forestlands as the least cost alternative available to the United States. Healthy, resilient forests sequester carbon. In the Trinities, we started 12 years ago, thinning overstocked stands both for hazardous fuels reduction and to improve the quality of the spotted owl habitat. Subsequent measurement has show increased growth rates in the remaining trees. The carbon sink is increasing. What is not so obvious is that forest restoration can also provide biofuels for transportation, reduce carbon intensive energy use in the industrial sector through combined head and power biomass plants, and reduce the carbon intensity of electrical power by co-firing coal plants with wood pellets and using woody biomass for electrical generation (a common strategy in the European Union). Four of the five strategies in the McKinsey and Co. report can be addressed through forest stewardship activities.

Climate Change and Wildfire: Social, economic and environment issues

There is no discussion in the McKinsey and Co. report on the GHG emissions from wildfire. However, some studies suggest wildfire and forest burning account for about 30% of global GHG emissions. Here in the United States, we average about

100,000 wildfire starts a year. About 50% of those are from human activity, about 50% from lightning. The precise quantification of GHG emissions from wildfire is still in debate. The California North Coast Air Quality Management District used Air Resources Board methodology to estimate the GHG emissions from two fire events in Trinity County—the 2002 Megram Fire (100,000 acres) and the 2008 Trinity Fire Complexes (200,000 acres). The estimates were 1.5 million vehicle year equivalents for the Megram Fire and 2 million vehicle years for the 2008 Trinity Fire. Vehicle years provides an urban frame for GHG emissions. For rural communities, however, the frame is weeks of smoke so thick you can't see across the street, increased chronic obstructive pulmonary disease (COPD) in our elders, salmon streams full of sediment, rivers and ponds filled with debris, the decline of our tourism/recreation industry, the loss of our precious timber resources, and, this year, the death of 11 firefighters. These are not the fires of our childhood when low intensity fires would “skunk around” in the undergrowth, herded by local ranchers and the Forest Service. Those fires were fires of renewal. Today's fires are those of ecological, social and economic destruction.

The Trinity Forest

The Trinity Forest is in the Northwest Forest Plan for the Recovery of the Spotted Owl. The primary driver of management activities in the Trinity Forest is preserving biodiversity, especially those species associated with old growth forests. The Spotted Owl plan led to a dramatic reduction in logging and the subsequent destruction of our economy (today the unemployment rate in Hayfork is 21.3%). At that time, (the early 1990s) the theory was that a forest protected from logging and a landscape of reserves and corridors would protect the species. Today, Jerry Franklin and Norm Thompson, the architects of that plan, encourage management in these vulnerable dry forests to reduce fire intensity and protect old growth forests. Their subsequent studies have shown increasing die-off in old growth stands due to changed hydrology. In 15 short years, climate change has dramatically changed strategies for endangered species recovery and old growth protection.

The forest restoration activities done today in the Trinity Forest are often called hazardous fuels reduction, but are actually much more sophisticated than a simple fuels prescription. Care is taken to enhance wildlife habitat, protect fire resistant trees, and minimize soil compaction and disturbance. Experience (and science) has taught us that the initial thinning must be followed by a prescribed fire and the area must be maintained by periodic burnings overtime. While these thinning and burning activities themselves produce some CO₂ equivalents, recent studies indicate that such pre-treatments can reduce the CO₂ equivalent emissions of intensive wildfire by up to 70% in some stands.

There is still much debate among the scientific community as to the carbon abatement values of such forest management (because of the carbon released during the thinning and prescribed burn and the uncertainty about whether treated areas will actually experience wildfire within a number of years). However, there is little debate (and significant evidence) that such treatments reduce the intensity and often stop, wildfires.

There is, likewise, debate regarding the removal of fire-killed vegetation after one of these fire events. The concern is that such “logging” negatively impacts the soil carbon and soil productivity. The people of Trinity County have now experienced “re-burns” in areas where fire-killed trees were not removed after the 1987 and 2000 fires. When stands of fire-killed trees dry for 8-20 years and then burn again, the fire is intense and resistant to control. The soil volatilizes along with the trees. There is no question that nearly 90% percent of the tree carbon and most of the soil carbon is released in this second burn. Ecosystem conversion often follows. The forest moves back to meadows, then brush fields and then, burning again, remain in brush. In the words of Tom Jimmerson, an experienced forest ecologist who lived and worked in the Trinity Mountains and Coast Ranges of California for years, after studying a re-burn in the Siskiyou Mountains, “We just blasted this area back to the stone age.” Some have said it would take significant investment in rehabilitating these sites, once they have been converted, if we want to reforest them.

A few cases studies were examined in a 2007 report for the California Energy Commission. In “Biomass to Energy: Forest management for wildfire reduction, energy production, and other benefits” the authors (Ganz, et al) modeled thinning, transporting, and converting biomass into electrical power in the Sierras and compared those models to the “no-treatment” models. Their findings show clear life cycle climate change benefits, including a 65 percent net reduction in greenhouse gas emissions. They also show a 22 percent reduction in the number of acres burned by wildfire and a dramatic drop in fire severity, showing a \$246 million savings in wildfire damage and \$13 million in fire suppression costs. They predict that even

greater reductions could be anticipated by strategically locating thinning projects in areas of high hazard. They also showed that about \$1.58 billion in power revenues, assuming an 8.3 cent kilowatt hour with a negligible amount of fossil fuel consumed in the harvest and production of that power.

This study points to the cross sectoral benefits of federal forest restoration: Jobs, renewable energy, reduced fire suppression costs, reduced resource damage and protection of wildlife habitat and carbon sinks. It helps us begin to put a frame of “ecosystem services” around federal land management. I believe it is this larger frame (which will include climate change mitigation) that should and will be the driver for federal land management for the foreseeable future.

Carbon Markets

For the purpose of carbon markets, there is great uncertainty regarding forests in general and their “quantify-ability” regarding carbon. The scientific community is careful to bracket their numbers regarding forest ecosystem carbon above and below ground with the caveat “within the limits of current measurements”. Likewise, estimates of fire CO₂ emissions are hampered by our lack of knowledge about carbon deposition, rates of atmospheric vs. soil incorporation of dead wood carbon, “real” soil loss, among other more esoteric topics. Undoubtedly, numerous conventions for forest carbon and forest carbon emissions from wildfire will abound over the next few years as better minds than mine tease out these important details. The CCAR in California is taking the lead on this and their work is enlightened and inspiring.

In most cap-and-trade approaches, forests do not fall under the cap, but they are still very important as “sinks” that sequester and store carbon and as “sources” that emit carbon (through wildfires, conversion, certain management actions, and mortality). Forest projects that sequester and store carbon or reduce emissions have been considered as carbon offset projects, but appropriate protocol for forest-sector offsets have been difficult to agree upon, partially because of the technical difficulty in applying “industrial” protocol to natural or biological systems and partially because of disagreement among policy interests. However, protocol such as the CCAR are moving forward through transparent, multi-stakeholder, working group processes. Currently, forest project options are limited to reforestation, conservation management, and avoided conversion, but the working group is trying to develop accounting approaches for appropriately quantifying carbon in harvested wood products.

One of the major protocol challenges is trying to account for the emissions benefits of integrated, cross-sectoral projects, such as forest restoration projects that enhance forest health, reduce wildfire risk and emissions, and provide woody fuels for bio-energy that offsets fossil fuels. (Interestingly, the CCAR has been able to agree to Urban Forest Protocol, but only allow the carbon directly sequestered in trees to be counted, not the avoided emissions associated with the well-documented energy conservation benefits achieved through shading homes and buildings.)

In addition, beyond carbon offset markets, attention is needed to develop forest management strategies that will: 1) help forests and communities adapt to the unavoidable effects of climate change; (We need to do vulnerability assessments at appropriate scales and help communities and agencies understand the management steps we need to take to keep our forests as forests.) and 2) help develop carbon mitigation strategies that public and private landowners can take to manage their forests in ways that will increase sequestration and storage or reduce emissions—even though they may not meet the same protocol being developed by the offsets markets.

Federal policy frameworks (e.g., cap-and-trade) that promote the establishment and trading of carbon credits through markets can help support rural communities. Such frameworks can stimulate entrepreneurial activity and encourage investment in forest-sector projects that provide credible and verifiable carbon benefits, while also enhancing ecosystem services and providing economic development opportunities for rural communities. It is critical, however, for these policy frameworks to:

1. encourage broad and diverse participation in forest-sector offset projects,
2. ensure that project scale enhances environmental and community economic gains,
3. maintain the sustainability of natural resources for future generations, and
4. benefit local communities.

The Cost (and benefits) of Carbon

We believe a cap-and-trade system and markets for carbon trading are coming. Our vision is a system of Payment for Ecosystem Services (PES) of which carbon is but one service. We know that water—another major ecosystem service—is on the

horizon as a policy issue with potentially huge market values and policy implications. We are also exploring information on “rights-based conservation.” However, those systems are in their infancy and the imperative of climate change effects on our forests are now. So today the great question is the source of the money to pay for federal forest restoration. The by-products of forest restoration and hazardous fuels treatments have little market value to date, largely due to uncertainty of supply.

Carbon offset markets:

Voluntary markets for carbon offsets, such as the CCAR, will provide additional revenue opportunities to private landowners, as these markets evolve and begin to function effectively. (Market function has a learning curve, as has been learned largely because of the European Union’s Emissions Trading Scheme (ETS). Private landowners will look for innovative ways to participate in these carbon markets, particularly as market credibility grows and as protocol for broad and clear participation is improved.

The RVCC also encourages the participation of public lands in carbon offset markets, so we are pleased to see the recent revision (December 2008) of the CCAR Forest Protocol to allow this. It must be clear, however, that public lands also need additional funding, beyond carbon offsets, for climate change adaptation and mitigation strategies, as discussed below.

Beyond Offset Markets

For the past ten years, the Rural Voices for Conservation Coalition has brought to congress two fairly detailed discussions: 1) a line-item by line-item analysis of an integrated forest restoration budget, and 2) a proposal for performance measures and accountability that would lead to integrated forest restoration implementation. Moving from appropriated dollars to payment for ecosystem services will take time, but help to foster an investment in services that will contribute to resilient communities and landscapes, while also reducing greenhouse gas emissions.

Traditional appropriations:

The annual appropriations for the federal land management agencies should continue to support the missions and programs of the agencies, while focusing on how to integrate climate change and other ecosystem services issues and developments into these programs. This is a strategic set of issues for the agencies and policy-makers. One day, perhaps, we will see a line item dedicated to integrated restoration with clear direction for its use.

Values/Revenues from Emission Allowances:

Policymakers should also include a portion of the revenues generated through the allocation or auction of emission allowances under a cap-and-trade system to the forestry programs noted in the RVCC priorities. Forests and natural landscapes represent an important part of our national carbon emissions flux, and they do not fit easily into the urban-industrial framework for carbon offset markets under cap-and-trade. They need additional sources of funding to address the threats of climate change, to capture the mitigation opportunities, and to recognize the essential co-benefits provided by forest-sector projects.

Forest Restoration and Rural Green Jobs

For the past 15 years, my organization and others like it have operated federal forest restoration and hazardous fuels programs. The job creation potential of federal land stewardship and restoration is tremendous. The proper investment of those dollars can create a world class, highly skilled, knowledge based workforce. Management for ecosystem services is knowledge intensive and requires a workforce committed to place.

Those jobs and skills include:

- Ecosystem surveys and data collection;
- data analysis;
- GIS analysis tools;
- collaborative facilitation;
- road stabilization;
- road removal;
- in-stream habitat improvement;
- wildlife habitat improvement;
- riparian protection structures;
- boundary line surveys;
- forest thinning;
- prescribed burning; and

- effectiveness monitoring.

This highly skilled “restoration” workforce can also be cross-trained for fire fighting, increasing the number of locally available, skilled workers for initial attack in fire emergencies. The restoration workforce will be able to put fuels treatments on the landscape to pre-prepare for fire suppression activities and thereby reduce the costs of fire suppression. They will also help in determining the proper use of fire during the year, and help implement those decisions.

Restoring the federal forests of the west, in order to protect and enhance carbon sinks and to make the forest more resilient in the face of climate change has other benefits to rural economies as well. The by-products of forest management (brush, smaller trees, etc.) can provide fuel to replace fossil fuels. But, scale is the issue. A network of small, community-scaled combined heat and energy plants will not require huge investments in transmission lines (up to 3MW of power can be transmitted over local lines). Such facilities also allow a community to diversify its economy, adding dry-kilns, green-houses and other heat users.

Likewise, as more local renewable power becomes available and as forested landscapes remains green and healthy, other green economy sectors may more eagerly locate in rural America. They will not relocate so easily to a landscape that looks like an ashtray. But, public policy must deliberately limit the scale and the ownership of these facilities. We have seen devastation in local communities from wood energy plants. In the North Eastern United States, for example, large wood pellet facilities replaced aging pulp mills. Not only did these 300,000 ton facilities monopolize the market for local wood, but the pellets were shipped to Europe for co-firing in coal plants. The locals were left with no ownership of the business, less diversity in their economic system, less fire wood for their own heating, and they were not allowed to purchase pellets from the facility. Similar plants are being built in the South West and in my home state of California.

After a forest burns in a stand replacing fire, the adjacent community loses many economic options. When the 1987 fires burned 67,000 acres in the Trinity Forest we recomputed the “allowable sale quantity”. It dropped from roughly 160 mmbf to roughly 40 mmbf. There are few stewardship opportunities in a fire-killed forest, aside from the erosion control efforts immediately after the fire. If the forest is federal, the fire-killed fuels are currently not removed, new trees are not planted, and the land is left to recover without the hand of man. So the community is left with no forest to manage and no forest products for decades. It is in our best interest, for many reasons, to help the forest accommodate fire, and not succumb to it.

Our rural federal lands communities are among the most vulnerable to climate change impacts. Not only is our landscape changing before our eyes, but when the markets kick in, we will disproportionately feel the weight of higher energy markets because our options will be more limited. Higher gas and diesel prices cannot push us to mass transit where no such systems exist. When higher electrical costs encourage increasing the energy efficiency of our homes, tax credits will only incentivize those who pay significant taxes. We are asking for a better solution for rural America. Help us be energy independent. Help us turn our forest thinnings into biofuels, heat and electricity. Help our contractors and workers access the work in the woods that improves the carbon sink and protects our forests from fire, insects, and disease. Help us create a network of community scale production facilities for wood pellets and wood energy.

Beyond the Trinity Forest

Community groups throughout the west have been working against the odds to restore America’s forests. We helped forge the agreements that led to the National Fire Plan. That agreement included five strategies: Fire Suppression, Forest Restoration (pre-fire and post fire), Hazardous Fuels Reduction, Community Assistance, and Accountability.

This integrated approach, which honors all the ecosystem services of the forest, including the service fire can provide, must be the basis of national climate policy as well. It speaks to the larger issue of maintaining our truly “green” infrastructure. Through our work with endless local collaborative groups we have learned that the social process is the key to creating good solutions and meaningful agreement regarding forest restoration.

The role of federal lands in combating climate change can be a national policy decision. How to achieve that, while maintaining habitat and economies, must be figured out and agreed to at the ground level. Top down will not work in this instance.

National policy addressing climate change, currently being developed in Congress will have dramatic effects on rural communities and landscapes. Specific components of national climate change policy, such as how resources are prioritized, credit allocation or distribution, offset eligibility, or the opportunity to participate in

emerging markets will affect rural communities and landscapes. Therefore, rural communities should have a role in the collaborative development of those policies. Because of the current uneven playing field between urban/industrial perspectives and rural/natural systems perspectives, there are a few principles we'd like you to consider:

1. Federal and state governments should foster the development and dissemination of reliable climate change information and tools to help build public understanding of the issues. Governments should especially help rural communities develop climate change assessments, strategies, plans, and monitoring schemes. We need to learn together and change together.
2. Federal and state climate change policies must ensure that low-income and other vulnerable populations receive assistance with climate change impacts. Needs of the rural poor may be significantly different than those of urban low-income areas.
3. Federal and state strategies for public and private forest land management should integrate climate change considerations within collaborative, landscape-scale restoration efforts.
4. Markets for forest carbon-offsets and ecosystem services should encourage broad and diverse participation, provide access and opportunity for rural communities, and clearly address issues related to project scale, sustainability, and benefits to local communities.
5. Federal and state climate change policies should provide technical and financial assistance to rural communities for capacity building and workforce training to implement both adaptation and mitigation strategies.

Ending Statement

So why should the federal government play a role in helping to address these challenges? And how should you proceed? The lands surrounding these communities are in dire need of integrated management, and there is an opportunity right now, though the investment of economic stimulus dollars, the development of new legislation around fire suppression and climate change, and the significant investment in renewable energy in the United States to think critically and act deliberately in ensuring that actions on federal land are playing a role in climate change adaptation and mitigation.

Climate change and the physical risks of climate change has led us to reconsider all of our federal forest management decisions and strategies on the Trinity Forest. The Trinity Forest is a nice little forest. It is over a million and a half acres in the Klamath Knot, one of the most biologically diverse areas on the planet. Please don't manage it for carbon. Manage it to be resilient. Manage it to prepare for the impacts of climate change. Manage it to be here for another 400 years. If you do, the carbon sink will come. The GHG emissions from wildfire will drop. The biofuels can be developed. The renewable energy will be developed and sustained. The owl and the coho will have a chance at survival. And so will we.

Mr. GRIJALVA. Thank you very much.

Our last panelist, Mr. Forrest McCarthy, Public Lands Director, Winter Wildlands Alliance. Welcome, and I look forward to your testimony.

STATEMENT OF FORREST MCCARTHY, PUBLIC LANDS DIRECTOR, WINTER WILDLANDS ALLIANCE, TETON VILLAGE, WYOMING

Mr. MCCARTHY. Thank you, Mr. Chairman and Members of the Subcommittee. I am Forrest McCarthy. I live in Jackson Hole in the Great State of Wyoming, and I am the Public Lands Director of Winter Wildlands Alliance, and I have been an Alpine Mountain and backcountry ski guide for almost 20 years.

During my travels, I have become the first person to set foot on B-15, the largest iceberg ever recorded, near the Ross Ice Shelf in Antarctica. As a physical geographer, I studied how rapidly warming temperatures are transforming land cover in arctic Alaska.

Today, I am testifying on behalf of the Outdoor Alliance, a coalition of six national, member-based organizations that represent the

interests of millions of Americans who climb, hike, paddle, mountain bike, backcountry ski, and snowshoe in our nation's public lands, waters, and snowscapes.

Not unlike indicator species, human-powered, outdoor pursuits can be seen as "indicator activities" because we are some of the first people to experience the impacts of climate change on our public lands.

A personal loss for me is the legendary Black Ice Couloir on the northwest face of the Grand Teton. Today, due to warming temperatures, all of that ice is now gone, and future generations of mountaineers will never have the opportunity to ascend one of the most renowned alpine climbs in North America.

Our community's self-interest in combating climate change is coupled with the insight on how Federal lands can help us meet this challenge, and we are honored to share those with you today.

First, Federal lands must facilitate ecosystem adaptation that protects flora and fauna but also takes into account the human aspects of the landscape. Adaptation policy should include preserving and protecting large tracts of open space, much of it on Federal land. Our system of national trails, and the critical open space through which they run, from the Appalachian Trail to the Pacific Crest Trails, is a model of how this can be achieved.

Taking care of our ecosystems must take precedence over how we enjoy and profit from them, but there is an argument for conceptualizing adaptation goals and policies a little more broadly. Because the ecosystems mean something to people, our adaptation policy should take into account how climate change will impact Federal lands as these lands relate to sustainable human uses, including the associated impacts to the outdoor recreation economy.

Second, Federal lands must simultaneously be protected as carbon sinks and thoughtfully developed for renewable energy. Federal lands contain millions of acres of forests and grasslands, so they not only store carbon but also remove it from the atmosphere. Federal lands can thus be used to combat climate change by maximizing the amount of forest and grassland.

We support a portfolio approach to land designation that includes wilderness areas, national scenic areas, national recreation areas, and, especially, open-space designations in close proximity to population centers.

To adequately reduce carbon emissions, alternative energy sources and technologies must be developed and pursued on Federal land. While the outdoor community welcomes the development of clean, renewable energy, we insist that this path is pursued in a balanced manner that takes into account other aspects and values of Federal land.

An example of this balance is the Federal Power Act's equal-consideration clause. When rivers are developed for hydropower, the equal-consideration clause ensures that the needs of fish and wildlife are addressed, recreational opportunities of the river are provided, and local communities' needs are considered.

The role for Federal land is thus to aggressively combat the increase in atmospheric carbon but not at the expense of other inherent values of the land.

Third, healthy Federal land is our common ground and can unify all Americans for the present and future challenges associated with combating climate change.

Stabilizing our climate will require change and sacrifice, but there must be some social rewards woven into the plan to assure that the public is vested in the effort over the long term.

Healthy public lands provide a tangible benefit for our sacrifices and commitment to protecting our climate. Our public lands provide the opportunity for Americans to stay connected to the natural world, and, through this connection, we will have the commitment and collective endurance to achieve this goal of stabilizing our climate.

In conclusion, we believe that facilitating ecosystem adaptation, protecting carbon sinks while supporting careful, renewable energy development, and motivating long-term public support for these challenges through enhanced Federal lands can be pursued in a manner where they can co-exist and complement each other.

When climbing North America's highest mountain, Mount McKinley, climbers make momentous sacrifices. The climb is expensive, grueling, and dangerous, yet, every year, over a thousand aspiring summiteers embrace the challenge, yet, every year, fear, tempered with planning and commitment, the suffering, with the splendor of the view from the top of North America, like climbing Mount McKinley, the road to a stable climate will be challenging and committing. There is a great deal of fear from inaction, but we have a great deal to gain by being thoughtful, decisive, and doing this right.

Thank you for the opportunity to appear before the Subcommittee.

[The prepared statement of Mr. McCarthy follows:]

Statement of Forrest McCarthy, Outdoor Alliance

Mr. Chairman and Members of the Subcommittee:

I am Forrest McCarthy. I live in Jackson Hole, Wyoming and I am the Public Lands Director of Winter Wildlands Alliance. I also serve on the Teton County Planning Commission, and have been an alpine mountain and backcountry ski guide for almost twenty years. As a mountain guide, I have had the privilege to spend a great deal of time in places like Antarctica, South America, Alaska and my home state of Wyoming.

During my travels I became the first person to set foot on B-15, the largest iceberg ever recorded, near the Ross Shelf in Antarctica. My time in the Polar Regions later inspired me to earn a master's degree in physical geography from the University of Wyoming, where I studied how rapidly warming temperatures transform arctic Alaskan land cover. By replicating historic photographs I documented not only the recession of glaciers, but also the thawing of permafrost and advancement of shrubs, tundra, and tree cover.

Today, I am testifying on behalf of the Outdoor Alliance, a coalition of six national, member-based organizations devoted to conservation and stewardship of our nation's public lands and waters through responsible human-powered outdoor recreation. Outdoor Alliance includes: Access Fund, American Canoe Association, American Hiking Society American Whitewater, International Mountain Bicycling Association, and Winter Wildlands Alliance and represents the interests of the millions of Americans who hike, paddle, climb, backpack, mountain bike, backcountry ski and snowshoe on our nation's public lands, waters and snowscapes.

Not unlike indicator species, human-powered outdoor pursuits can be seen as "indicator activities" with respect to climate change because we are some of the first people to experience the impacts of climate change on our public lands. Declining snowpack shortens ski and snowshoe seasons, makes alpine climbing more dangerous and can eliminate ice climbing altogether. Less snowpack also means less water in our creeks, rivers and lakes for paddling. Higher temperatures and pro-

longed droughts create severe imbalances in forest, alpine, desert, and river ecosystems that stress native species and degrade the quality of the outdoor recreation. One of the results of this imbalance, increased wildfire activity, directly impacts pursuits such as rock climbing, hiking and mountain biking and our collective ability to enjoy public lands.

A personal loss for me is the legendary, Black Ice Couloir, a challenging ice climb high on the northwest face of the Grand Teton. Today, due to warming temperatures, all the ice is gone and future generations of mountaineers will never have the opportunity to attempt one of the most renowned alpine climbs in North America.

The outdoor community's interest in climate protection is axiomatic—the places where we conduct our outdoor pursuits and that support the \$730 billion annual outdoor recreation economy are imperiled by a warming climate. Our self interest in combating climate change, however, is coupled with some distinct insight as to how our federal lands can help us meet this challenge, and we are honored to be able to share these insights with you today.

As of late, it seems that the primary role of federal lands in combating climate change is to passively provide evidence of not only the existence of climate change, but also the rapidity with which it is taking place. We envision a more proactive, three-part role for federal lands in combating climate change.

I. Federal Lands Must Facilitate an Ecosystem Adaptation Policy That Protects Flora And Fauna, but Also Takes into Account the Human Aspects of Federal Lands

In prior Congresses, both chambers generated thoughtful legislative approaches to climate protection. Wisely, some of these approaches directed towards ecosystem protection some of the revenues from market-based efforts to cap and reduce carbon. As we understand it, adaptation is the portfolio of efforts to counteract the effects of a warming climate on ecosystems and the flora and fauna therein.

Federal lands are where much ecosystem adaptation activity will take place, and federal land management agencies will likely play a material role in designing and implementing adaptation policy. Adaptation policy should include preserving large tracts of open space through a pragmatic approach ranging from protective federal designation to voluntary conservation easements. Adaptation must also include physical structures and land management techniques to facilitate migration and land use planning that puts a premium on contiguous open space. Our system of national trails and the critical open space through which they run, from the Appalachian Trail to the Continental Divide and the Pacific Crest Trails, may very well assist in this objective.

A universal aspect of human-powered outdoor pursuits is that they take place outdoors in a context that includes not only the topography and gradient of a given place, but the flora and fauna as well. The ecosystem is not merely the setting for our pursuits; it is the very substrate. Taking care of the ecosystem must take precedence over how we enjoy and profit from it. We say this without qualification given the longstanding conservation and stewardship ethic in the outdoor community. This said, we also think there is an argument for conceptualizing adaptation goals and policies a little more broadly.

Long before people recognized the idea of an ecosystem, individual parts were honored through everything from creation myths and totem poles to the landscapes of the Hudson River School artists and our government's foresight in creating a National Park System almost 100 years ago. In addition to being the home to plants and animals, ecosystems and landscapes mean something to people, particularly to Americans. We suggest that as adaptation policy is developed and implemented, some consideration is given to how climate change will impact federal lands, waters and snowscapes as they relate to sustainable human uses. Consideration should include not only human-powered recreation uses, but also the associated economic impacts to the outdoor recreation economy and other traditional uses such as hunting, fishing and wildlife enjoyment.

This concept was explored last Congress in the Leiberman-Warner Climate Security Act of 2008, S. 3036, where a provision specifically directed the Secretaries of the Interior and Agriculture to take into account “the potential to provide enhanced access to land and waters for fishing, hunting, and other public recreational uses” when making spending decisions for adaptation purposes. S. 3036, 110th Cong. § 4702(c)(4) (2008). We encourage both chambers to further explore this concept as it develops climate protection legislation in this Congress.

II. Federal Lands Must Simultaneously Be Protected As Carbon Sinks And Thoughtfully Developed For Renewable Energy

Federal Lands as Carbon Sinks

Our federal lands contain millions of acres of forests and grasslands. As trees, plants and other organic material not only store carbon, but remove it from the atmosphere through photosynthesis, we think that another critical role federal lands can play in combating climate change is maximizing, to the extent practicable, the amount of forest land, both old growth and reforested areas.

Protecting and enhancing forest carbon sinks can be pursued in a number of ways, but primarily through land designations and strategic acquisitions that protect existing forests and reduce development sprawl. We support a portfolio approach to land designation that includes wilderness areas, national scenic areas, national recreational areas, and especially open space designations in close proximity to population centers. These goals need not wait for climate protection legislation, but could be achieved, in part, by permanently protecting inventoried roadless areas in the Forest System, passing the Omnibus Public Land Management Act of 2008, and reauthorizing the Federal Land Transaction Facilitation Act before it expires in 2010.

In addition to the protective designations and strategic acquisitions of federal land itself, there may be a role for federal land management agencies to facilitate or encourage the protection of state and private forestland for its carbon sink attributes.

Thoughtful Renewable Energy Development

Despite the great assistance forested federal lands provide in climate change mitigation from their natural function, such mitigation will not offset man-made carbon emissions enough to protect the climate. To adequately reduce carbon emissions, alternative energy sources and technologies must be developed and much of this development will take place on federal land. While the outdoor community heartily welcomes the chance to reduce the nation's reliance on energy sources and technologies that damage our climate, we insist that this path is pursued in a manner that takes into account other aspects and values of federal land. Given the scale of renewable energy projects needed to adequately deal with climate protection, the landscape impact of renewable energy projects, including solar arrays, wind farms (and the necessary transmission lines) may very well dwarf the landscape impacts of traditional energy projects.

As evidenced by our nation's current hardrock mining policy, when a single use of federal land is generally allowed to trump all other uses, the costs will eventually outweigh the benefits (especially if the policy is essentially left in place for 137 years). Thankfully, there are other federal laws on the books that balance the multiple uses of federal land more evenly, such as the Federal Power Act, 16 U.S.C. § 791a, et. seq. In outlining the powers of the Federal Energy Regulatory Commission (FERC) to issue licenses for the construction of hydropower projects, the statute requires FERC to:

[G]ive equal consideration to the purposes of energy conservation, the protection, mitigation of damage to, and enhancement of, fish and wildlife (including related spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality.

Federal Power Act § 797(e), 16 U.S.C. § 791a (2008).

The practical effect of the equal consideration language, and the fact that hydropower projects are subject to a fixed term of 30 to 50 years, is that FERC must balance power and non-power values in their decision process. When rivers are developed for hydropower, mitigation measures ensure that the needs of fish and wildlife are addressed, recreational opportunities on the river are provided, and local communities' needs are considered. In other cases where ecosystem and recreation values outweigh the value of the river for hydropower development, projects are not constructed or in some cases removed at the end of their license term.

The outdoor community believes that analogous language to the Federal Power Act's equal consideration clause should be used to guide the pending development of alternative and renewable energy projects on federal land. We also believe that this language may be appropriate for other endeavors to reduce carbon in the atmosphere, such as subterranean carbon sequestration, or other yet to be developed engineering techniques. The role for federal land is thus to aggressively combat the increase in atmospheric carbon, but not at the expense of the other inherent values of the land.

Aside from legislative direction, we also feel that it is incumbent upon all public lands user communities, from recreation communities to the businesses that rely on

federal lands, to work directly and proactively with the renewable energy community. We believe this effort should develop common ground, and possibly some best management practices for assuring that renewable energy production and transmission can coexist with other sustainable uses of federal public land.

III. Healthy Federal Land is Our Common Ground and Can Unify All Americans for the Present and Future Challenges Associated with Combating Climate Change

Climate change is typically framed in dramatic and sobering terms. Currents of fear and guilt associated with an energy-intensive existence permeate much of the conversation, and there is great anxiety not only over the changes to the natural world, but the anticipated changes to the American economy and way of life. Though fear can be an excellent motivator in the short term, too much of it can lead to fatalism and apathy. Climate protection legislation is really only one of the first steps in a nation-wide effort that will last for decades. Fear must be tempered with hope and the expectation that there will be some positive developments along the way.

When climbing North America's highest mountain, Mount McKinley, climbers make momentous sacrifices. Ascending McKinley is expensive, long, grueling, and dangerous. Yet every year over a thousand aspiring summiteers embrace the challenge. When climbing McKinley it is critical that climbers respect the mountain and understand the inherent risks involved. However, if an expedition exercises careful planning, good judgment, team work, effective communication, acute awareness, and commitment, the risks can be managed and the goal of reaching the summit obtained. Like climbing McKinley, the road to a stable climate will be challenging and committing; we must not be fearful, but rather thoughtful, careful and decisive.

Stabilizing our climate will require change and sacrifice, but there must be some public rewards woven into the plan to assure the public remains vested in this critical effort over the long term. Healthy public lands provide a tangible reward for our sacrifices and commitment to protecting our climate and the ecosystems that depend on it. Public lands provide citizens with the opportunity to view wildlife, play in the rivers and snow, test one's skills on a steep rock or a single track, and experience first-hand the natural world. The importance of our public lands transcends their value as refuge for wildlife or as natural carbon sinks, they are the refuges for people as well. Our public lands provide the opportunity for Americans to stay connected to the natural world. Only through this connection will we have the commitment and collective endurance to achieve the goal of stabilizing our climate.

Conclusion

As Congress pursues this daunting, but profoundly necessary legislative effort; Outdoor Alliance encourages a central role of science and perhaps a new level of bureaucratic flexibility to better cope with the interrelated nature of the challenges ahead.

Because different parcels of federal lands are managed according to the priorities and peculiarities of the different land management agencies' organic acts, there is some utility in exploring new ways that the federal land management agencies can work collaboratively on climate protection. Likewise, we believe that the three roles for federal lands outlined in this testimony—facilitating ecosystem adaptation, protecting carbon sinks while supporting careful renewable energy development, and motivating long-term public support for the associated challenges, should be pursued in a manner where they can coexist and complement each other.

Thank you for the opportunity to appear before the Subcommittee.

Mr. GRIJALVA. Thank you very much for your testimony.

Let me ask a couple of questions. Mr. Ridgeway, going back and referencing that fourth point about the involvement of private landowners in the process of identification and development of corridors, the discussion today has been about public lands, but the question is, how should private landowners be involved and connected to this process that you pointed out that they are an essential part of as well?

Mr. RIDGEWAY. Yes. As you point out, Mr. Chairman, private landowners will be very essential to the protection of wildlife corridors because, of course, so many of those corridors are on private lands, and I think we will be discovering, with more clarity, just

where those overlaps are as we begin this process of identifying further all of the wildlife corridors in the United States and across North America.

Our coalition wants to bring tools to the table, tools that can be used by private landowners to allow them to continue to live and ranch on those lands but do it in ways that are consistent with long-term survival needs of wildlife, and tools, such as conservation easements, are very useful toward those goals. And we want to work together collaboratively, as a broad-based group, again, to bring the resources to the table that can be used, in that case, by private landowners to, again, ranch, maintain, and manage their properties in ways consistent with the wild animals that are on them.

Mr. GRIJALVA. Are there particular wildlife corridors that Freedom To Roam can identify now?

Mr. RIDGEWAY. Yes. There are many, and they come in two different categories. There are corridors that migrating animals use to get from A to B seasonally. There are also corridors that non-migrating animals use to get between their different populations, which, if cut off, ruin those populations, as you saw on that map with the lynx.

Perhaps one of the best known and identified and understood corridors in the United States is the path of the pronghorn that I showed you briefly in our presentation, and that one is well known because wildlife biologists have collared animals and followed them as they have gone from beginning to end on that corridor, and they know the boundaries and the measure of it very accurately.

Interestingly, that corridor crosses public lands. It starts in a national park. It then goes across the bridge at Teton National Forest. It then enters into private lands, and most of those are ranches, but some of those ranches have already been subdivided, forcing the animals into the forest, where they prefer not to go.

Antelope, because of their predators, like to stay in the open. They have eyes that can see for miles, and they hate going in the trees, and that path of the pronghorn corridor has almost been permanently disrupted because of two subdivisions of ranch lands that, given the resources, might have been able to avoid that subdivision, and that is, again, the resource that we want to bring to the table for private landowners.

Mr. GRIJALVA. Thank you. Mr. McCarthy, the public lands are being called upon to help address our energy needs. Part of this whole discussion in the Full Committee and this Subcommittee will be the calls for increased oil and gas extraction and also the creation of a new capacity for nuclear energy production, which involves uranium mining near places like the Grand Canyon, for instance. But there is also discussion about creating a balance between the extraction/protection side of this question.

The user groups you represent, the outdoor industry that you represent; how would you define that balance?

Mr. MCCARTHY. Mr. Chairman, I think the best model for that, as I mentioned earlier, is the Federal Power Act, with the equal-consideration clause, that was used on rivers, and, taking into account the history of damming rivers, that, in future river projects

for energy, other attributes, including ecological recreation, need to be considered.

I also think a good model is to look at these things proactively. I know there is an organization in Wyoming called the Biodiversity Conservation Alliance, which has already, in a Geographic Information System (GIS), mapped out all of the important areas for wildlife in the State of Wyoming and then overlaid with wind potential to say, these are the areas that have critical wildlife value and are not appropriate for wind development. These are areas that we need to proceed cautiously, and these are the areas where they do not have any conflict.

Mr. GRIJALVA. Regulatory and statutory changes; would that be part of the equation in developing balance?

Mr. MCCARTHY. Well, you asked, earlier in the hearing, appropriate of NEPA, and I think, you know, in consideration of those projects where environmental assessment of these projects, is it an appropriate application of that?

Mr. GRIJALVA. Thank you. Ms. Jungwirth, you mentioned your experience in your community of Trinity. Could you talk to us about the impacts that you have seen of climate change that you have witnessed on Federal lands from that very close perspective that you have?

Ms. JUNGWIRTH. Sure. We have seen the size of fires move from a 100-acre fire to a 200,000-acre fire in the period of about 40 years.

We have increased chronic obstructive pulmonary disease (COPD) in our elders, as the Hoopa Reservation, which is next door to us, they have really documented that.

We have seen dewatering of streams. We have seen forests converting to brush fields.

Last year, we lost our tourism and recreation industry that we were trying to diversify to, as a public land community, because nobody wants to come and look at an ashtray and breathe smoke.

We will lose our lake-resort tourism business this summer because of the low waterflows, and we are also trying to diversify our economy by growing grapes, and the grape crop—you know, they will not press smoked grapes. They actually test for smoke in California to see how bad it is for your grapes, and our grape crops were thrown in the garbage can.

So it affects every single aspect of our lives.

Mr. GRIJALVA. Thank you. Mr. Holt, any questions, comments?

Mr. HOLT. Yes, Mr. Chairman, if I may.

Mr. Ridgeway, first of all, thank you for coming, and I commend you on your work for Freedom To Roam.

It seems to me that this is a pretty complicated idea. In some sense, it is very simple. You just have these corridors, or “string of emeralds,” or however you want to call it, but, it seems to me, it is really very complicated to figure out how you can have a corridor that, clearly, if it is going to be interrupted with fences, well, you might make those fences passable for pronghorn or lynx. If you design it to make it passable for them, it might not be passable for other species.

So I wanted to find out how well developed the idea is. I think there are, certainly, some ecologists at Princeton I know and at

other places who having studying these things, but how thoroughly is it studied so you can find an optimal design for these things so that they will pass all of the critical species, and how do you determine the length? You talked about, for the pronghorn, you need a couple of hundred miles, I guess, but, for other species, you might need a thousand miles.

So where does one get the information that puts all of this together to come up with an optimal design for how the corridors would be put together?

Mr. RIDGEWAY. Well, it has to be, of course, based on best science, and that science is provided by wildlife biologists, and, as you pointed out, it is specific to species, that multiple species will use certain corridors, like the pronghorn corridor is also used by mule deer migrating north and south. In fact, the mule deer do not have problems with the fences because they can jump right over them. Pronghorn are forced to crawl under because, as an animal that runs very fast, they cannot jump high, so they have to go under.

Again, the solutions are species specific. Again, in the case of mule deer and pronghorn in that area, in Montana and Wyoming, one of the critical factors in protecting their corridors is also protecting them with road crossings. In the case of both species, they can be lured and directed by fencing that they cannot get over or under into underpasses, but the underpasses have to be designed, again, to accommodate the needs of the specific species.

In the case of a pronghorn, the underpasses have to be wide enough and open enough and not so tunnel-like that they are inhibited from crossing under them. A mule deer is easier to actually get to go through an underpass, and there are many underpasses that have been finished recently in Southern Wyoming that are very successfully being used by mule deer.

There is much, much work to be done, by species, to, again, identify their specific needs, not only where the corridors are but what their needs are within those corridors. So that is work still to be done. We believe that our coalition can provide a great benefit by organizing many of the groups regionally around the country that are working on different aspects of this. They are often working independent of each other.

One of the great jobs that needs to be done, for example, is to identify where their habitats are going to shift to under different global-warming scenarios.

There are several groups around the country that are starting on that right now. We are discovering that they do not even know about each other yet. Scientists working on habitat shift, under global-warming scenarios here in Washington, D.C., with the Geological Survey, for example, do not know that colleagues out in California, at the Academy of Sciences, are doing the same thing.

So we can provide a great service by coordinating those groups, regionally and internationally, that are beginning the work, all of the work, that has to be done, and it is very extensive. It is going to take some years, I think, to achieve the final goals, but it has to get started now.

Mr. HOLT. Which brings me to my next question. On what time scale are we talking about? If we are going to accommodate vari-

eties of species and bring together all of this information, as you say, it is going to take a long time. How much time do we have? What is the time scale for which we will acquire land or acquire rights-of-way or whatever else needs to be done?

Mr. RIDGEWAY. In my testimony, I said, we are entering unknown territory here. We do not know the answers to those questions precisely.

The shift that you saw for the lynx; it was using the IPCC models developed in 2007 for the most pessimistic predictions that were out there at that time. We are two years later. The pessimistic predictions that you saw up there are now the middle-of-the-ground ones. That is the average that we chose to present to you. It is a shifting target. There is not much time on this. We have to get started right away.

We believe the first step, as I said in my testimony, is to work together with your Subcommittee, especially, to achieve a definition of what "wildlife corridors" are. That is the first step.

With a definition of what they are, corridors can begin to be identified and then designated. We would very much like to work with your Subcommittee to figure out how to make that happen. Those are the first steps, we believe.

Mr. HOLT. Thank you. Thank you, Mr. Chairman.

Mr. GRIJALVA. Let me ask the gentlelady from Wyoming, Ms. Lummis, for her questions or comments.

Mrs. LUMMIS. Thank you, Mr. Chairman.

Well, first and foremost, I would like to welcome Mr. McCarthy to our hearing. This is a fellow gentleman from Wyoming, and I am delighted to see you here and am pleased that you have chosen to share your time and expertise with us.

You know, as I do, that tourism is Wyoming's second largest industry and contributes \$2.6 billion to Wyoming's economy, and a lot of that spending occurs on activities on public lands. So I am delighted that you have chosen to join us today and speak of your experiences in Wyoming and the West.

Here is a quote that I am going to give to you from Gifford Pinchot, who was, of course, the first chief of the Forest Service: "Conservation is the application of common sense to the common problems for the common good," very much a wise-use doctrine, and it essentially serves as the last century's Forest Service motto.

Much of your testimony follows a similar line of thinking; that is, we pursue new renewable energy projects and fuels-reduction strategies and other public land uses and that we do so with moderation in mind.

So my question, Mr. Chairman, is about adaptive management flexibility, and would you agree that adaptive management flexibility for our public-land-management agencies is a key tool to protecting the concept of share use, and what specifically are your thoughts in that regard?

Mr. MCCARTHY. Well, thank you for the warm welcome, Representative Lummis.

"Adaptive management." By "adaptive," you are referring to ecological.

Mrs. LUMMIS. Correct, Mr. Chairman.

Mr. MCCARTHY. I think I would put a premium on open space.

One of my other hats I wear is I am the planning commissioner in Teton County, in a county, 97 percent of which is Federal land. Currently, we are redoing our comprehensive plan that oversees some of the private lands that include the path of the pronghorns that Mr. Ridgeway spoke to.

What I would address is we are currently trying to encourage conservation easements in those places. So putting together tax incentives and land trades to be able to protect those areas is one adaptive way I look at to accomplish this goal.

Mrs. LUMMIS. Well, Mr. Chairman, that is music to my ears. I was involved in the Wyoming Stockgrowers Agricultural Land Trust, and we hold, along with the other rangeland trusts in the West, the Partnership of Rangeland Trusts, or "PORT," the largest number of rangeland conservation easements in the United States, and it is a magnificent testament to public and private efforts to conserve land because, of course, wildlife does not know whether they are on public land or private land. They migrate according to habitual practices.

So I am delighted to hear you say that. I look forward to working with you on conservation-easement issues. The tax advantages that were put into the Farm Bill last year made an enormous difference in our State of Wyoming, in terms of adding to the number of conservation easements that were donated for the tax advantages by people who, but for the tax advantages, would not have been able pencil out the opportunity to conserve land in that manner.

So, again, Mr. McCarthy, thank you so much for joining us. I yield back, Mr. Chairman.

Mr. GRIJALVA. Thank you very much.

As this Committee continues to explore this priority issue of climate change on the Federal lands, I want to thank all our panelists today for a really excellent start.

So, as we go through this, there are obvious things—examination of statutory and regulatory issues as this Administration defines the issue of "balance" in terms of extraction and protection—that will fit into the discussion we need to have here.

I think the important point, and the impression that I have from all of our panelists, is this is a real issue, and it has got to be taken seriously and dealt with seriously.

Thank you very much for an excellent start, and this meeting is adjourned.

[Whereupon, at 5:35 p.m., the Subcommittee was adjourned.]

